

Aviation Week & Space Technology

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A McGraw-Hill Publication

September 17, 1962

SPECIAL PHOTOS:

**P.1127 VTOL
Takeoff
Sequence**



Hawker P.1127

60 CPS REF & EVENT

Honeywell test instrumentation records structural soundness of missiles

System records 112 test parameters simultaneously

Wyle Laboratory, at its Norco, California, facility, tests the structural soundness of Minuteman, Polaris, and Skybolt missile stages under transportation conditions with a battery of four multichannel Model 1002 Vibration oscillographs. The total Wyle-Honeywell system at the Wyle test site includes 1002 Vibration oscillographs, 84 Anadatan III amplifiers, and a 14 channel FM type system.

The Wyle test site uses Wyle hydraulic shakers of about 150,000 force pounds, mounted on million pound concrete reaction blocks—the only installation of its magnitude in the country. The hydraulic shakers reproduce vibration into the missiles comparable to those encountered during transportation prior to launching.

The specimen record shows data recorded from accelerometers on the third stage of a missile at the launch site marked on the record.

The fidelity, contrast, and easy readability of all Honeywell Vibration records is vividly shown in this record. Where traces are sometimes read at this complexity or greater, the time-identifying intertriggers, occurring at regular intervals along the time base of the record, make it easy to identify the individual traces.

For details about Honeywell Signal-Conditioning equipment, the Model 1002, and other Vibration oscillographs, and the LAR 7400 FM Type 841 oscillograph, write: Honeywell, Inc., Industrial Division, 2000 E. Dry Creek Road, P.O. Box 370, Denver 10, Colorado. Telephone DDD Area Code 303-759-4311.



The Honeywell LAR 7400 FM type system stores 14 channels of data. A battery of multichannel Model 1002 Vibration oscillographs directly records 112 parameters of information.

Honeywell

Facts in Control

CAPABILITY

is spelled

f-u-e-l p-u-m-p-s

Inherent high contamination tolerance and pressure balance of vane-type fuel pumps for turbine engines ensures high reliability and increased service life even under less-than-ideal operating conditions.

Fuel pumps capable of operating without inlet filters are now a reality as the result of the Vickers Advanced Design vane-type fuel pump's ability to meet the rigid contamination tolerance requirements of MIL-E-50093.

Benefits resulting from elimination of the inlet filter include reduced weight, improved system reliability and cavitation characteristics, and reduced maintenance.

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Pressure Balance—All pressure-induced radial forces are balanced resulting in zero radial loading on the shaft bearings. Direct benefits are low bearing and journal wear, reduced weight, higher speed and pressure capabilities, increased reliability and service life.

Mounting flexibility—Basic pump cartridge can be an integral part of a fuel control body or provided as an independent pump with or without provision for fuel control mounting. Weight and overall package size reductions are substantial with integrated designs.

Vickers vane-type fuel pumps are capable of operating at pressures ranging to 1000 psi and higher at normal fuel speeds—small size units can operate at speeds to 20,000 rpm. They can be produced in sizes providing 100 to 70,000 pounds per hour.

Get more data in Bulletin A-5242A. Vickers Incorporated, Detroit 33, Michigan.

Continued, designed to meet MIL-E-50093 (free water, sharp silica sand, coarse Arizona road dust and dirt), is delivered continuously by conveyor at rate of 40 grains per 1000 gallons of fuel during contamination tests. Liquid contaminants are added simultaneously.



Decrease pressure induced radial loads are balanced, need for making rotor and bearing journals integral is eliminated. Rotor drive allows rotor to align itself properly with side plates, independent of bearing journals and journal wear.



Two vane-type fuel pumps, typical of the Vickers line currently available, include the unit on background rated at 60 gpm at 3400 rpm and 1000 psi and the unit in foreground rated at 4.5 gpm at 6300 rpm and 1000 psi.

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POWER TRANSMISSION
POWER CONVERSION
FLUID TRANSFER**

20 CPS 20/SEC

AEROJET OPERATES COLUMBIUM LOOP WITH BOILING CESIUM OVER 2000 HOURS AT 1850°F



Progress in Nuclear Space Power

Development of nuclear space power systems with a high power-to-weight ratio (in the range of 10 lb/kw) is predicated on the use of alkali metals as reactor heat transfer and heat source working fluids. Are the corrosion properties of these metals compatible with present design concepts of space power systems?

Work on the cesium-columbium system, under AEC sponsorship, began at Aerojet General® Nuclear on September 15, 1961, with operation of the first refractory metal loop specifically designed for forced convection corrosion tests with boiling cesium. Specific heat data were obtained, and in October 4 the loop was put on a continuous, long-term corrosion test, unattended, until December 27, 1961, when it was shut

down for metallurgical analysis. A similar loop was tested successfully for the AEC in April 1961 with rubidium at 1800°F. Besides demonstrating the feasibility of using columbium alloys to contain boiling cesium for extended periods at turbine inlet temperatures of 1800°F, the experimental work has yielded valuable information on the intermetallics and corrosion of boiling loop systems.

AGN metallurgy tests also developed new liquid metal handling and analytical techniques, and tests conducted and operated apparatus for determining the density and vapor pressure of rubidium and cesium. Work is continuing on the heat transfer, corrosion, and thermophysical properties of cesium and other liquid metals to assure the long-term reliability of space power systems.

AGN's Metallurgy Department contributes to materials technology in design of power reactors, space power systems, nuclear fuels, basic chemistry, and plasma physics.

AEROJET-GENERAL NUCLEAR, San Ramon, California



Engineers, Scientists, investigate outstanding opportunities at Aerojet General.

AEROSPACE CALENDAR

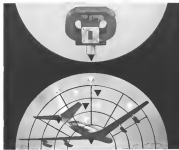
(Continued from page 5)

- Sept. 27-28-Fifth Annual National Conference and Technical Exhibit, Aerospace Industries Association, Sheraton Hotel, Boston, Mass.
- Sept. 28-29-Society of Experimental Test Pilots, 26th Annual Airside Banquet and Symposium, Beverly Hills Hotel, Beverly Hills, Calif.
- Sept. 30-Third Annual Aerospace Photocongress, AHS, Calif. Open to the public 10:00 a.m. to 4:00 p.m.
- Sept. 30-Oct. 5-Fourth Pacific Area National Meeting, Aerospace Society for Testing and Material, Santa Monica Hotel, Los Angeles, Calif.
- Oct. 1-3-Sixth Annual Engineers & Scientists Air Traffic Control Assn., Washington Hotel, Las Vegas, Nev.
- Oct. 1-3-National Communications Symposium, Institute of Radio Engineers Hotel, Union, N.Y.
- Oct. 1-5-Northeast Commerce and Industry Exposition, Commonwealth Assn., Fairfax, Va.
- Oct. 2-19th Annual New York State Aviation Conference, Mark Twain Hotel, Albany, N.Y.
- Oct. 2-4-Symposium on Physics and Non-Destructive Testing, Canada Hotel, San Antonio, Tex. Arranged by Southwest Research Institute.
- Oct. 2-4-Third Symposium on Advanced Propulsion Concepts, Cincinnati, Ohio Co-sponsored, AIAA, Control Electronic.
- Oct. 2-4-National Symposium on Space Electronics and Technology, Institute of Radio Engineers, Pennsylvania Hotel, Miami Beach, Fla.
- Oct. 2-4-16th Annual Meeting and Conference, National Business Aircraft Assn., Four Seasons Hotel, Pittsburgh, Pa.
- Oct. 6-14th Annual Reunion, U.S. Naval Test Pilot School, Naval U.S. Naval Air Station, Pensacola, Fla.
- Oct. 7-International Northern American Council Meeting, Union City, Calif.
- Oct. 8-10th Annual National Electronics Conference & Exhibition, McCormick Place, Chicago, Ill.
- Oct. 8-12-National Assembly & Space Engineering & Manufacturing Meeting & Display Society of Automotive Engineers, The Americana, Los Angeles, Calif.
- Oct. 9-11-National Airport Conference, American Assn. of Airport Executives, University at Oklahoma, Norman, Okla.
- Oct. 10-12-Lens in Focus & Related Exh. Photo Conference, American Society of Photo, Palm Springs, Calif.
- Oct. 10-12-15th Annual Aerospace Electronic Exposition/Report, Aerospace Electronic Society, Pan Pacific Auditorium, Los Angeles, Calif.
- Oct. 12-15-Symposium on Photography of Structures, Display, Skunkworks, Lockheed, Palmdale, Calif.
- Oct. 12-15-Symposium on Photography of Structures, Display, Skunkworks, Lockheed, Palmdale, Calif.
- Oct. 15-17-Pitt Meeting, International Scientific Radio Union & Institute of Radio Engineers, Ottawa, Canada.
- Oct. 17-17-NW Meeting, General Hotel, Boston, Mass. Sponsored by the Aerospace Sciences, U.S. Navy.

(Continued on page 9)

Pulse magnetrons, used in commercial all-weather radar systems, are part of the extensive line of Litton microwave tubes and display devices. For information write to: San Carlos, California. In Europe: Box 110, Zurich 50, Switzerland.

LITTON INDUSTRIES
ELECTRON TUBE DIVISION



PROBLEMATICAL RECREATIONS 136



If a certain six digit number is split into two parts, one consisting of the first three digits and the other the last three digits, and the two parts are added and the resulting sum squared, it is found that the product is the original six digit number. What is the number?

Any ingeniously disposed engineer will tell you that the size of the parts must equal the whole in a successful system. Our Data Systems Division is looking for just such Systems Analysts to work on large-scale, complex data-gathering and display systems. The job involves determination of parameters for future systems as well as current projects. Advanced degree preferred. Call Mr. Harry P. Lee.

ANSWER TO LAST WEEK'S PROBLEM: Among many solutions we offer one: number the square in horizontal rows as follows and start the "Knight's Tour" with the square numbered 1, proceeding in serial order: 1, 40, 13, 28, 3, 36, 15, 38, 24, 31, 2, 38, 16, 23, 4, 48, 41, 22, 25, 38, 31, 62, 29, 16, 36, 23, 38, 61, 54, 57, 68, 51, 42, 58, 56, 63, 52, 17, 30, 22, 35, 64, 33, 60, 59, 6, 47, 43, 10, 33, 26, 45, 8, 11, 18, 34, 21, 44, 9, 32, 19, 46, 7.

LITTON SYSTEMS, INC.
Data Systems Division
Georgetown, California

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FOR ENGINEERS AT ALLISON**

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New engines are being developed to meet urgent requirements in the fields of VTOL, Nuclear Power Generation, air defense and other uses.

Unique new engines utilizing the proven T-56 Turbo Prop can supply the boundary layer control wing flaps. Applied to a C-130 Hercules this means full speeds and maximum thrust the demands needed for take-off and landing.

Current Allison efforts to improve the state of the art in turbine engines also includes programs designed to maximize fuel economy and range through air cooled turbine blades and a new thermal regenerative cycle.

Acceleration of these and other solid, advanced turbine engine development programs, backed up by long-range production requirements, creates immediate opportunities for engineers—B.S. & M.S.—experience preferred:

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- THERMODYNAMICISTS
- MECHANICAL DESIGNERS
- CONTROL ENGINEERS
- DEVELOPMENT TEST ENGINEERS

Positions involve work in design and development of advanced turbine engines including components such as new compressors, turbines, reduction gear assemblies, turbo machinery for use in industrial field, etc. Test areas include planning test requirements, conducting tests and evaluating data on newly designed hardware. Good opportunity for progressing into design engineering.

Recent Atomic Energy Commission announcement of negotiations with Allison in prime contractor for development of a Military Compact Reactor has also created challenging, long-range opportunities in the nuclear field, as well as in above fields.

Openings available NOW. A promising future for those who qualify is available in the creative environment at Allison—plus all the opportunities and advantages offered through an organization with the character of General Motors. Interested? Let us hear from you. Send your resume to write to: Mr. V. A. Rhodes, Professional and Scientific Placement, Dept. 111, Allison Division, General Motors Corporation, Indianapolis 6, Indiana.

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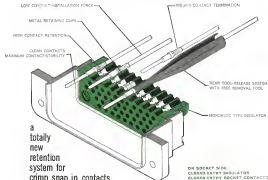
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Sea support demands the best. Bell's HU-1E meets this demand.

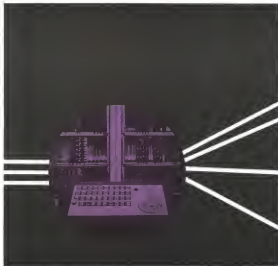
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3. Electric control fluid exchanger



5. All electric control system



6. Fluid leaks, pressure, pressure relief



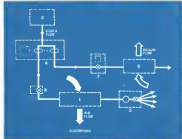
4. Hydraulic power supply—dual pump system



8. Steel ball seal exchanger



9. Welded stainless steel O-Rings



7. Miller hydraulic valve



8. Steel ball seal exchanger

PARTS OR PACKAGES

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Much higher reliability ... slightly higher price

In order to furnish parts with a confidence level acceptable to the user, manufacturers must design beyond normal or "standard" use requirements. At Deutsch, this concept is the guideline for all design criteria. We exceed the minimums in every applicable specification to assure our customers of continuous performance above and beyond documented requirements. For instance, our DID ball-lock and BTK bayonet-lock connectors exceed, by far, the latest revision to MIL-C-40060. Here are just a few examples:

- Deutsch-developed aluminum materials provide better wire and interfacial seal against altitude and moisture... assure temperature performance above 300° F... guarantee better dielectric characteristics and dimensional stability under exposure to oils and fuels.
- Contact retention of DID exceeds the 35 lb specification by more than 80%.
- Fluid coupling rings make sure the connector remains a complete unit throughout assembly... provide proper force engagement... assure proper mating and lack of play and receptacle.
- Positive visual lock indicators afford inspection

ability for correct connector assembly and engagement.

- Millivolt drop, measured by the latest specification techniques, is 50% below the minimums before and after corrosion testing. And, corrosion resistance is at least five to five times higher at 300° F. than the specification's minimum at room temperature.
- Insertable and removable contacts are crimp terminated to military standard geometry, and are held in place by mechanical devices that insure retention, contact alignment



and are replaceable if damaged.

➤ MIL-C-40060 electrical performance ratings, at altitude, are met and exceeded at 110,000 ft. instead of at the specified 80,000 ft.

These and the many additional advantages of DID and BTK connectors may cost a little more, but in terms of value analysis are good lower due to assembly time savings, repeatability and, perhaps most important, favorable MTTF ratios under actual use. If you are faced with criteria calling for a high confidence level rather than just meeting a specification, we suggest you get all the facts on DID and BTK performance from your local Deutschman, or write for Data File R-9.

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TABLE 2. *Staphylococcus aureus* and *Staphylococcus epidermidis* MICs

88,100 copies of this issue printed.



Outboard view of installed brake

Wing fixed, brake removed

Pressure plate removed, exposing bearing carrier

Simpler to Service

The Navy's new A-7 Vigilante has a unique brake system, with brakes mounted on the outboard side of the wheels. This simplifies maintenance, as wheels and brakes can be inspected and serviced without pulling the wheels.

B F Goodrich built this unique system to North American Aviation specifications not only to simplify service, but reduce the need for it, too. By mounting the brakes outboard, away from side and street, brakes

get the benefit of air cooling. The design also helps keep brake dust away from the tires.

A corollary advantage is in flexibility for modifications. Additional disks can be added, if desired, without major design changes. If you want the best in aircraft brake experience and ability, come to B F Goodrich. For information contact B F Goodrich Aerospace and Defense Products, a division of The B F Goodrich Company, Department AW-3, Troy, Ohio.

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'In Dublin's Fair City'

The easy charm of Dublin was a contrasting backdrop to the most serious and thoughtful Annual General Meeting the International Air Transport Assn. has held in at least a decade. This eighteenth such gathering, presided over by Jeremiah F. Dempsey, general manager of Aer Lingus, grappled resolutely with such sticky problems as price cutting below IATA fares by member airlines, and for the first time in many years, faced up to a crisis from the outside gave them an unvarnished view of how they look from a customer's seat.

Although many IATA members are obviously not used to bulbs as sharp as those tossed at the delegates by Lord Brubaker of Tara, the experience did them an enormous amount of good in contrast to the steady diet of add salutation that has too often characterized the annual meeting programs. For an industry that is so completely dependent on public confidence and support and which maintains such huge public relations establishments, top airline management has remained remarkably indifferent to and isolated from public opinion. Then, we think Mr. Dempsey had an excellent govt in inviting Lord Brubaker to express his views, for he certainly shook many of the delegates out of their complacency with their handwork. If some of his bulbs were overly sharp to make his points, they needed to be to penetrate this complacency.

The airline business is not in very bright shape the world over, and it is going to take some intelligent and vigorous action to get it back on the black ink trail where both stockholders and passengers are equally happy. We do not share the general gloom over the future prospects of the international air transport industry forecasted by the \$10-billion-plus operating loss for 1981. That is certainly not a happy sign, and it is a highly conservative estimate of the full scope of this financial fiasco. But already there are signs of hope on the horizon in new passenger and cargo revenue and some technical pooling of ground service equipment and spare parts.

No industry could hope to manage a basic technical revolution such as the jet age without a period of temporary trouble. Technically, the jet age has made a remarkably smooth transition but airline managements have not adapted to its realities with modern perspective, and hence for many of the IATA members' current problems. Full immersion in the jet age has sharpened the contrast between the goals of two basic groups of IATA members—those airlines whose primary mission is to fly their customers flag around the world and those with the infinite possible costs to their nation's taxpayers and those who are in business to make a healthy profit and pay dividends to their stockholders. The brutal economics of the jet age are making the task of the first group difficult, if not impossible. Their type of general, overvalued operations simply don't fit the jet transport, which must be flown constantly with heavy loads to make money. If it is not, it will cost a competent management out of house and home like a race horse confined to the stable.

Thus we predict the coming IATA conference in Geneva will develop into a battle between one type of management that wants to retreat to a high-fare plateau where it thinks it will find protection, and another type of management that will gain for broadening the air transport market with lower promotional fares. This

same type of cleavage was evident during the meeting's discussion of the supersonic transport, where the protectionists pleaded for a 50% surcharge on such service, presumably to make it as unattractive as possible.

The tough stand on enforcement of IATA rates taken by the executive committee and not openly opposed to the Annual General Meeting is interesting because the current business is quite different from the one prevalent haggling in the Middle East that has gone on for years. It represents a deliberate effort by some major airlines to penetrate new markets with cut-rate tickets and an effect buy a foothold in a new market area. It is that policy that has stirred the ire of their competitors who are noticeably feeling the effects of this penetration. While nobody was willing to defend rate cutting on the meeting floor, and even the proved offenders possessed to be good best in the future, it will be interesting to see how this move is resolved in the upcoming traffic conference, where the sharpest minds in the business would the sharpest swordsmen.

Another subject not normally discussed in Annual General Meetings is safety, but here again Dublin has proved an exception. We have warned the airlines editorially that this is a subject they cannot continue to sweep under the rug since jet age crashes have a new momentum and public impact far greater than ever before. As Sir Hudson York correctly pointed out, the public is not the slightest bit tolerant in tribute per hand and million miles if the total liability rate continues to rise and if front page stories of jet crashes regularly jar their confidence in air travel. There is a lot the industry can do internally and externally to improve the safety situation, and it is high time they accelerated their efforts.

Shades of the coming supersonic transport cut a pall over the meeting, indicating that some delegates felt the shape of its wings to be more like those of a vulture than a delta. There is a general fear among the smaller airlines who perhaps are already too deep into their subsonic jet venture, that one of the larger airlines will upset the apparent and have a mad rush into supersonic by placing the first order. This is, of course, always a possibility, but it is highly improbable that such an event is imminent because of the problems still remaining in the technical development of such a beast. Although IATA has been very in following every turn of the supersonic technical road as it unfolds, its members could have their current effort more profitably in solving the problems of the subsonic jet age rather than turning new about supersonics that are realistically a decade away from being a genuine airline proposition.

It is a heartening sign of maturity to see the Annual General Meeting devote an increasing portion of its time to stimulating debate on the very real problems of air transport, although their solution lies elsewhere. However, all of this serious talk was alleviated by the mad but undoubtedly efficient staff of Aer Lingus which did fall, as the natural charm and atmosphere of Dublin and the Irish countryside to provide an effect rest not provided by more lush efforts of the past. Despite their criticism with some of his criticism, it is obvious that delegates to the 1981 Annual General Meeting freely took Lord Brubaker's advice when he told them, "You are for a week in our dear, wee old Dublin to confer. Make the most of it. You have much to do."—Robert Hutz



Removing was problem for Haynes because their dies to form wheels

Intricate in shape—yet strong at 1700° F

Cast turbine wheels from this batch of ceramic shell molds will meet the most exacting performance standards of a quality-conscious industry. They'll be made to withstand steady operation at high loads and at temperatures up to 1700 deg. F and higher.

This is just one of many advanced foundry processes used by Haynes Steelite to produce castings. For a closer look at others, write for the booklet "Haynes Alloy Castings and Fabricated Parts."

Remember: Haynes Steelite can always supply you with the right alloys—including those that are vacuum-melted and vacuum-cast. And, complete design and tooling service, production, routine or special finishing. Any part, size, shape, quantity.

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Washington Roundup

Rising Cuban Tension

Secret Rumsfeld last week hailed Cuba, Berlin, U.S. reconnaissance flights and nuclear test ban negotiations as a long statement warning that an assault on Panama Canal Center's mission is in the beginning of a new era. In the midst of a decade-long U.S. war and representatives for nations ranging all the way from state statements to blockade and invasion of Cuba Moscow indicated it will not send offensive missiles to Cuba. "Our nuclear weapons are so powerful in their explosive force and the Soviet Union has such powerful missiles to give their nuclear warheads that there is no need to search for sites for them beyond the boundaries of the Soviet Union," the statement said.

No one has kept some recently, but late in 1999 the Central Intelligence Agency said Russia had used nuclear diplomacy or "bulletin blackmail" to threaten 15 countries in more than 40 occasions since 1950 (AW Jan 2, 1991, p. 13).

Secretary of State Dean Rusk issued a secret joint meeting of the House Armed Services and Foreign Affairs committees last week to review the Cuban situation last week. The committee is apparently just the opening step of ongoing analysis in secret, but Rusk is understood to have and the Cuban briefing still is delicate in nature, and the U.S. is working closely to ensure that it becomes no more than that.

Space Study Group

Detailed re-examination of the arbitrary potential of space is being made by a special study group of civilian scientists and officials, experts organized by the White House. A report is due before Thanksgiving. The group was formed before the recent flights of Vostok 3 and 4, in a result of criticism that Defense Department was making too much in space. It is believed to consist of about a dozen people.

Chairman John E. Moss of the House Special Government Information Subcommittee is demanding an explanation from National Aeronautics and Space Administration on why it withheld information on the flights of Vostok 3 and 4 until Aug. 14 when it published its Shuttle Situation Report. Rep. Moss wants to know what grounds are used to justify secrecy or withholding tracking data. The Moss killer worked in NASA Administrator James F. Webb, but not have acknowledged by him last week. He submitted a post letter from the House, and Senate space committee chairman the Webb asking for data on Soviet space failures was answered in one day (see p. 18).

ARPA Units Afield

Advanced Research Projects Agency, which answers to the Director of Defense Research and Engineering, is controlling new combat developments. Two Combat Development Training Units are active in South Vietnam and Thailand as part of ARPA's Project Agile. Project Director Robert C. Phelps has the interesting job of assessing ARPA's director for needs and conflicts. GDTC programs develop those of the services, especially Army and Air Force. Two weeks ago the Joint Chiefs of Staff announced that the Department effort, which has special issue analysis and focus in the field, is put under one director—probably a civilian one. The recommendation came last approval, provided Phelps be the man in charge.

Technical presentations on the TFX to Soviet tactical fighter were made at USAF's Aeronautical Systems Division last week by General Chairman and Boeing. Core presentations are due to be made today. Final presentation in the Office of Secretary of Defense is to be made on Oct. 22.

First North American XB-70 Mach 3 bomber will be rolled out in Palmdale, Calif., late this month or early in October. It is scheduled to fly late in October. Second aircraft is due to fly next September and the fourth in July of 1964.

North American Air Defense Command is pressing for development of a Mach 3 intercept aircraft. It made a new design, under that an aircraft of the North American F-105, which was cancelled three years ago. Defense Department is expected to ask NORAD "Where is the Mach 3 bomber that the new interceptors is supposed to intercept?" Pentagon officials say NORAD's real goal is a long-range Mach 3 plus aircraft which might make a compromise.

Green light has been given for full production of the USAF-Douglas Skybolt air-launched ballistic missile. Funding for July and August was reduced in increments (AW Aug. 27, p. 20) but production money for the remainder of 1962 and research and development money for all of the fiscal year ending next July has not been reduced. The third flight test of the Skybolt last week produced a third failure.

Watch for announcement that another Polish submarine tender will be based in the Indian Ocean area, probably at Perth, Australia. Navy and last week that the Polish tender Proteus will be based at Agaña Harbor, Guam. A Navy law frequency monitoring station will soon be under construction at the eastern tip of Australia. This tip of eastern ridge, in some instances can generate to intercept signals, already is located on Gales, Hawaii, in Miami and in the city of Washington.

—Washington Staff

Kennedy Stresses Peaceful Space Theme

U. S. must gain lead to keep space from becoming battleground, President says during tour of centers.

By Edward H. Kohn

Honolulu—Commander-in-chief denunciation of the U.S. space program seemed certain last week as President Kennedy and key members of his Administration hammered on the theme that U.S. leadership in peaceful space exploration will deny the race of space by Soviet Russia as a battleground.

In his one-day during a two-day presidential trip to the Defense Department and National Aeronautics and Space Administration facilities that the President and his top advisers consider space one of the critical fields in the war of ideologies, but that the threat posed by Russia's space program is not one that will alter the fundamental U.S. policy of exploring space for peaceful purposes.

This came essentially that the Air Force, which sees the recent Soviet Vostok flights as a significant setback in the U.S. space race, will not sell this position either to Defense Department or to the President.

President Kennedy's official party on his trip included what amounts to the first review board for U.S. space programs—Defense Secretary Robert S. McNamara, Dir. Harold Brown, director of Defense Research and Engineering, Air Force Secretary Eugene Zachert, and Air Force Chief of Staff Gus

Curran E. LeMay. None of them is an advocate of a gradual, incremental approach to space, with Brown and McNamara decidedly in favor of an early, rapid pace.

Because a considerable portion of the President's trip involved secret briefings at NASA installations it is believed that NASA will be directed to be prepared to implement space programs rapidly. The President's trip also included a top NASA official told McNamara that if this is so, it has not altered down to the program level. He said NASA has been prepared to be

Radiation Belt Satellite

Washington—U.S. will launch a 100-lb. satellite to probe the radiation belt around the earth which is expected to study the artificial radiation belt around the earth which is expected by the U.S. to high altitude nuclear detonations [see p. 32].

The Delta-headed satellite will have the Table 2 communications system from the Atlantic Missile Range schedule. Table 2 was scheduled for Oct. 30.

New radiation satellite will contain cosmic particle experiments being made by National Aeronautics and Space Administration's Goddard Space Flight Center, Bell Telephone Laboratories, University of California and University of New Hampshire. NASA estimates the project will cost \$10 million.

First orbit will take the satellite between altitudes of 10,000-170 mi. on an inclination of 79 deg. to the equator. Orbital period will be about 100 hours.

satellite and will continue to be. The satellite, he said, is that the satellite will not be getting its full capabilities until the manned space flight program.

Although the President's trip to the Marshall Space Flight Center, Alabama Missile Range, Manned Spacecraft Center and the McDonnell Aircraft Corp. plane was billed as a business trip to obtain first-hand knowledge of the program, NASA officials here say it is a demonstration of strong support for the manned space program and for a space budget that will approach \$50 billion in the coming fiscal year. Fiscal 1964 budget requests are being made final now, and will be submitted to Budget Director David E. Bell on Sept. 30. Bell accompanied the President.

The Administration's philosophy on the use of space for peaceful purposes is subscribed to by the Pentagon civilian leadership, but some deep-seated disagreements on methods are becoming apparent (see box).

Rup Albert Thomas (D-Tex.) who led the behind-the-scenes effort to have the Manned Spacecraft Center located in Houston, said Wendell W. Brown, Marshall director, "I've read more money for NASA. I've got it." Rep. Thomas, chairman of the House Independent Citizens Subcommittee, made his remark while on his way to New A leading probably will be deferred in favor of programs directly related to lunar orbit missions.

"The President made brief remarks at each stop. He commented the U.S. space policy line of the only knowledge of the trip. 'We have a word that we shall not say it [space] governed by a hostile

dog of conquest, but by a banner of freedom and peace," the President said. "We have vowed that we shall not see space filled with weapons of mass destruction, but with instruments of knowledge and understanding."

For the rest of his tour on only he believed it was in the nation's best, and therefore, we must be first. In short, our leadership in science and technology, our hopes for peace and security, our obligations to ourselves as well as others, all require us to make this effort.

I do not say that we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and explored without fear of the fires of war, without repeating the mistakes that we have made in excluding the use of nuclear space in our hands. The President said.

This apparently means that the satellite space program will remain relatively low-level in comparison with the rapidly expanding lunar program.

President Kennedy said he expects his discussion of May 25, 1961, "to shift our efforts in space from how to begin to how to make the most important decisions that will be made during my presidency in the office of the President."

Highlights of the presidential trip: • Houston—Secret briefing on the guidance and control laboratory, a look at the White House flight center and at a 15-ft. static firing of the fourth Saturn V flight booster.

• Atlantic Missile Range—Complex 14, where Col. Walter M. Schriener's Minuteman Atlas-Centaur was tested in Atlas 100-B booster on Sept. 10 for a flight test scheduled for Sept. 28. From 2 Complex 15, Saturn V Complex 14, secret briefing on the Saturn program.

• Thursday drive in the Saturn flight test, which delayed the test of a new



PRESIDENT KENNEDY and party with Saturn static test at Huntsville, Ala.

hypergolic motor, to be used in the Atlas for this flight.

• Houston—Secret briefing at Rice University, rocket landing on a manned Apollo flight program, explaining the lunar orbit rendezvous technique, look at mockups and models of Apollo space craft and lunar extension module vehicles.

At the Manned Spacecraft Center, NASA chief of public for the first time a full-scale model of the enormous model. The model 17 ft high and 22

feet across the base of the legs, was built by North American Aviation, Inc., prior to NASA's decision to use lunar landings. North American is building the Apollo.

• St. Louis—Secret briefings on German and advanced German look at engineering mockups of Minuteman and Gemini spacecraft.

At each stop, the President stressed the requirement of being first in space to maintain peace. At AMRL, he noted that Soviet Russia was able to give priority to its political system and Russia to its program that it is an advancing nation and the U.S. is on the decline because of Soviet space efforts. He said the nation has made the decision to be first, even though "we started behind. We have a long way to go."

Both in Houston and St. Louis, he pointed out that the space program, which now costs each U.S. citizen 40 cents a week, will "cost over 50 cents." This could mean that the President is losing the groundwork for a substantial supplemental request for NASA in January (AW Sept. 3, p. 16) which would eliminate the need for a taxable manufacturing in order to go into production on the lunar extension module and lunar logistics system and to pay for more deliveries in Contract funding.

Top Officials Debate Rendezvous Choice

Huntsville, Ala.—Two opponents of the lunar orbit rendezvous technique for landing men on the moon argued at space top National Aeronautics and Space Administration officials in brief of President Kennedy during his visit to the Saturn development building here last week.

The issue pitted Dr. James H. Woods, presidential science adviser, and Dr. Harold Brown, director of Defense Research and Engineering, against James E. Webb, NASA Administrator, Kenneth Holmes, command space flight chief and Wendell W. Brown, Marshall director.

Woods and Brown apparently held the downed technique a too complex, and from the earth orbit rendezvous method, which had been the leading candidate until studies indicated lunar orbit rendezvous could cut two men and save 10-15% in program scheduling and costs (AW July 9, p. 2).

Dr. Robert C. Woodward, Jr., assistant NASA administrator, told Kennedy Week after the meeting that the evidence could not be constructed in a simple, but was seen as the outcome of a technical discussion. Brown said he did not feel the evidence in NASA program, since he is a Defense Department representative. Nevertheless, Woods was heard to say "no good" design was Brown's explanation of lunar orbit rendezvous to the President.

Dr. Nicholas E. Golovin, Woods's deputy, was a strong supporter of lunar orbit rendezvous when he headed a panel studying large boosters (AW Nov. 6, p. 2). The method also was favored by Brown and used high NASA officials until the recent studies, but NASA is now settled on the lunar orbit rendezvous technique.

The exchange, which was broken up by the President with a picnic, now have prompted from Brown's subsequent endorsement dedication to the President. "You promised me would lead on the moon in this decade, and I feel we'll do it," the method was endorsed by Sen. Frank Chabot, a St. Louis Democrat, Missouri, by deputy. Sen. Robert Scott, Missouri's Senate representative, Sen. Zachert, and several other members of the President's party.

Later in his tour, the President was given a welcome briefing on lunar orbit rendezvous at the Manned Spacecraft Center, which has focused that method since its inception.

Olympus Space Station Proposed

Washington—Development plan for a Russian space station called Project Olympus has been submitted by National Aeronautics and Space Administration Headquarters to the Manned Spacecraft Center, with the understanding that the project be approved and funded now for a 1964 test flight.

Station would consist of a hull and three spokes which would be erected like an umbrella. Crew would be ferried to and from the station in Apollo-type capsules, and the station C-1 launch vehicle would be used to boost both orbit and ferry. Plans call for launch of a station in approximately six months, and 32 and 34. Docking ports would be located on the ends of the spokes, and on the top and bottom of the hull.

Olympus is an effort by Manned Spacecraft Center to get its own design on record before a final NASA decision is made as a space station development. NASA's Langley Research Center, following a joint Langley study, has reported on the feasibility of a 30-ton station, which could be launched in the mid-1960s with a C-1 vehicle (AW Sept. 10, p. 3). Langley design has an inflatable rim, and the Manned Spacecraft Center configuration has no rim.

Administration Is Testing Space, Defense Funds as Economic Tools

By George C. Wilson

Washington-Kennedy Administration two after months of study is trying several new contracting procedures designed to direct more federal defense and space dollars to areas which need them most.

The effort addresses debate on whether the government should rigidly defend and space contracts to stimulate or as tools for tailoring such as the actual economy. How the Kennedy Administration addresses the question will shape the government's contractual relationships with the aerospace industry.

Right now the Administration is trying to get more economic leverage out of defense and space spending by working within the procurement framework by Congress. But President Kennedy's campaign to stimulate the economy may well lead to acquisition legislation to make it easier to channel this money to small business and colleges and to areas of chronic unemployment.

Thomas D. Morris, assistant director of defense for institutions and logistics, last week told the Senate Select Small Business Committee that the Administration had succeeded at recent as a five-year trial in the percentage of defense dollars awarded to small businesses. Morris said that \$2,622,400,000 or 97.7% in fiscal 1962 Defense spending went to small businesses. This compares with those amounts and percentages in previous fiscal years: 1961—\$3,677,800,000 or 15.9%; 1960—\$4,000,000 or 38.1%; 1959—\$3,778,000, 60.0% or 16.0%; 1958—\$5,728,000, 60.0 or 17.0%.

Morris said the opening was partly due to the Defense Department's "Operation Booster" which gave all the Pentagon procurement organizations quotas and measured performance weekly in channeling contracts to small business.

For Fiscal 1963, Morris said the military departments and Defense Supply Agency are developing quotas to help increase prime government contractors. These quotas for each service and the DSA will become final Oct. 15.

He predicted the recent Defense contracts going to small business would be \$100-\$125 million in each of the fiscal years through 1965.

Sensibly, Morris said Defense would help itself from get more subcontractors from prime contractors. He predicted small business Defense subcontracting would increase by \$100 million each of the three fiscal years through 1965.

He estimated the total value of Defense subcontracting to small firms in fiscal 1962 would be \$17 billion, compared with \$55 billion in Fiscal 1961. Morris said the civilian services have been directed to keep track of the number of small business subcontracting set by DOD's 365 largest prime contractors. He said quotas would be set for each subcontractor.

Chemist John Spurland (D-Ala.) of the Senate Select Small Business Committee told Armstrong Wertz, head of the "Operation Booster" program, that the federal government is not making Defense contracts to small business. He said it was unlikely, however, that small business would ever obtain 25% of the Defense dollars available because of the way in which the federal government can perform the best contracts.

Besides helping small businesses, the Kennedy Administration is exploring ways to use defense and space dollars to stimulate area industrial growth and unemployment. This effort is being carried on the Senate small business by Sen. Hubert H. Humphrey (D-Minn.), a party leader who in the second ranking Democrat on the small business committee. He contends it is high time to regard defense and space dollars as tools for stimulating the national economy, and in discussing new approaches.

From the Senate, Morris said that the federal government is doing so little to direct its spending. He advocated "some kind of an economic or economic advisory group, at least to let the small business community know where the federal government is going to have the following problems in this area of our lives."

At Massachusetts, whose state has suffered from the shift of Defense money away from the Midwest, also contended that industry is attracted to areas with research resources. "If research and development contracts are not made quickly distributed, it will be true as well as the scientific and technical personnel and facilities on a geographical and regional basis in the smaller—very old and very young to get the plants better distributed because places have a tendency to follow the R&D."

As things are now, Sen. Humphrey said, each legislator must fight intensively for his own constituents. "I am almost ashamed of myself," he said. "I spend months in it, even hours a day trying to get benefits into my area." This has become an obsession with him. "I don't make much sense than the other fellow,

you do not get anything," he said. Ron M. Linton, director of economic development policy within the Defense Department, agreed more could be done to reach Defense dollars with small economic needs. But he said he mostly was an adviser to Defense officials, not a policy maker. He said the mission of his office was to help implement the Defense Management Policy No. 4 which states, in part: "Success of the Defense program depends upon efficient use of all resources, including manpower and facilities which are produced through purchase of the skills of both management and workers."

As part of this effort, Linton and Defense is experimenting with a new version of the aerospace program. As it is now, "contracting is based on the fact that the federal government is not making it in two or three economic production runs. He said the restriction is usually impractical. The new plan would be to contract for the understanding the prime will produce a fixed percentage in a labor surplus area or subcontract it to that area.

Ernest W. Bucklett, National Association and Space Administration director of labor surplus areas, told the committee the government's aerospace program for labor surplus areas cannot be used by the space agency because its procurement of needed areas is not likely enough to be applied only two or three economic production runs. However, he said, NASA is encouraging prime contractors to subcontract in labor surplus areas.

From the committee, administrator of the Small Business Administration, last week told the committee "it is severely recognized that the private technological complexities involved in the aerospace industry are a barrier for the government in inducing private sector participation." For small business firms. Because of this trend, Morris said the government must provide a prime contractor with the capability of absorbing his orders into quantities and components which are, without exception of these in cost efficiency, be supplied separately according to the skills and capabilities and labor as embedded into the complete product.

Congress last week established the Area Redevelopment Administration to help areas suffering from chronic unemployment. Although the agency is just getting into full swing, Army Administrator Harold W. Williams told the Senate small business committee that an early expansion is being considered to help depressed areas. One such area is being considered in West Virginia, where an agency representative is working full time to help businesses be more accessible to government contractors.

Chinese U-2s Seek Nuclear, IRBM Data

Washington-Chinese Nationalist Lockheed U-2 reconnaissance aircraft have made about 100 flights over the Communist Chinese mainland, usually on 4,000-m. round trips that take them to a point in western Kiangsu province near China's intermediate ballistic missile range. One purpose of the flights has been to monitor the upper atmosphere for signs of an expected Chinese nuclear test in adjacent Szechwan province (AWM May 3, p. 17).

Commentators claimed last Sept. 9 that a U-2 of the air force of the Chinese People's Liberation Army shot down a U-2 of the Chinese Kowloon which intruded upon the airspace in east China."

U-2 Reward

By late last week it had not and how the aircraft was brought down or whether the pilot was alive. In July and again in August, the Chinese Communists offered \$200,000 in gold to any Nationalist pilot who defected to the mainland with a U-2.

Interference, From Cuba

Washington—U.S. Kennedy Kowloon (U.S. Y) and last week that Soviet radio and electronic equipment has infiltrated to Cuba in "deliberate effort to put the Communists in a position where they can interfere with the American effort at Cape Canaveral."

He said U.S. astronauts might be sitting under for an end of interference. The Soviet might want to step in. The Atlantic Division for the Mercury program said the radio command ground units might be developed by Gen. and Chinese and Russians by the Atlantic U-2s. He responded signed order: Nationalist aircraft might be able to find the possibility of more interference in the future.

A CIL spokesman told Armstrong last week that to put the system "in a way would probably have to be done in the future." He said the system is "in the air."

The Atlantic Missile Range has been monitoring all radio signals going to a station to locate possible interference. Observers suggest a more stringent monitoring for the Communists would be to maintain the observation of the Air Force's recent frequency diversity system was installed along the Gulf Coast of Florida Air Force Base and the Atlantic Missile Range.

He said the system is designed to jamming and interference from the large boats at the Cape.

U.S.-owned U-2s have been flying in secret missions from Alaska, Hawaii, the Philippines, Japan, Okinawa and other locations. They have not penetrated the Chinese mainland, but flights from the Philippines and Okinawa have flown over the water at high altitudes for deep looks inside China, where the Communists have a strong of airfields along the coastline.

The Chinese Nationalist government has contended that it bought two U-2s from Lockheed in July of 1960, two months after a U.S. U-2 flown by the Nationalist Chinese Air Force was shot down by a Soviet SA-2 missile. The U.S. State Department said an expert known was used for the two aircraft.

Both State Department and Defense Secretary McNamara declined to comment on whether other countries also had bought U-2s from the U.S.

American Air Minister David Hughes announced on Sept. 7 that the Nationalist pilot who shot down the U-2 would be given a reward of \$200,000 in gold.

At late in June of this year, Chinese Nationalists said they were making approximately three flights a month over the mainland. The Nationalists maintain that these flights are not responses because the mainland belongs in the Republic of China and not in the Communists.

Chinese military officials last week refused to say whether they would continue flights over the mainland. They said they had not been able to learn the exact location of the loss of the U-2, but it had been downed near the border of the island.

Commenting China's Minister of Defense Marshal Lin Tiao contended the air force was for "undergoing preparedness" but did not indicate what method was used to down the U-2.

There has been concern among some U.S. observers for many months that Soviet or Chinese might have the ability to shoot a politically important time and place to attempt to down a U-2. The nature of the Chinese mainland flights has made them a likely target.

There has been private speculation that Soviet or Chinese might have fighters equipped with rocket boosters enough make 30,000 ft in case enough to start altitude to launch a missile effectively against a U-2. Fighters at Kienlin's U-2s have been reported equipped both with single and double boosters.

State Department said some Nationalist Chinese pilots trained in U-2s in the U.S. in 1960 but none had been trained here since. There were other indications, however, that Chinese Nationalist pilots trained in U-2s in Taiwan as late as April, probably at Langley AFB, Del Rio, Tex., where Strategic Air Command operates some U-2s.

Nationalist Overflights

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New SSD Commander

Mr. Gen. Ben Felt USAF will formally assume command of Air Force Systems Command's Space Systems Division this week, succeeding Lt. Gen. Harold E. Jones who has become vice commander of Systems Command at Andrews AFB, Md.

Mr. Gen. Felt's move will see Gen. Felt's move to Air Force Logistics Command at Norton AFB, Calif. Gen. Mitchell had been vice commander of AFSC.

Gen. E. Harold Ford will be vice commander of the Air Force's SSD. Assistant vice commander will be Brig. Gen. Harry Brown.



Proposed V/STOL fighter by Short Brothers & Harland incorporates a bank of four 4,000-lb thrust Rolls-Royce RB153 Mk engines on either side of the center fuselage section. Engines are installed along the trailing edge of the delta wing, while conventional stores are supported by a single Rolls-Royce RB168 located in the fuselage. Design, designated the PD-16, was submitted to the North Atlantic Treaty Organization competition for a V/STOL. One-variant fighter PD-15 would have a Mach 9 speed capability at low altitudes and could disengage from the surface at 100 ft.

British Display Models of Future VTOL Fighters

Model with stylized line configuration of the Hawker P1154 Mach 2.5 V/STOL fighter designed as a sub-1960s replacement for the Hawker Hunter close-support fighter for the Royal Air Force was on display at Farnborough on the British Society stand (AW Sept 18, p. 38). Two place version also may be ordered by the Royal Navy. Model shows proposed configuration for installation of the RB168-R, thrust British fighter RB168-R vertical thrust parafuel. Strong air intake nozzle, however, will not be a full delta in shape on the model. Now also will be seen, though shrouded and somewhat shorter. Tail will be larger, and the canopy will have a greater area, resembling that of the Sea King P1127.



Rare design of the Reynolds-Palmer D-24 Albatross, below, incorporating a 35,700-lb thrust version of the RB168 also was on display at the Royal Society stand. Built around the variable-geometry concept, aircraft has a variable delta wing with stores on the trailing edge. U.S. Defense Department may order at least two prototypes.



AEC to Manage Spur/Snap 50 Project

Washington—Management of the Spur/Snap 50 sounding space power project has been assigned to the Atomic Energy Commission in a reorganization agreed upon last week by that agency, Defense Department and National Aeronautics and Space Administration. The project office will be headed by an Air Force colonel responsible to the AEC. He will coordinate Defense and NASA work on the project through special deputies in each of these two agencies.

Operation of the Spur/Snap 50 program is to develop an auxiliary space power system of approximately 500 lb, which could operate for 10,000 hr and have a specific weight of 50 to 20 lb for each kilowatt generated. Until now the joint Congressional Atomic Energy Committee has conducted management responsibility in such a way that it was leaving the program. At Force was managing Spur, and Snap 50 was an AEC project.

Harold Brown, director of Defense Research and Engineering, indicated before the committee last week that the Defense Department would like to have the AEC take over the project because of the Atomic Energy Commission's experience in space power projects. "Clearly parallel" the nuclear atomic propulsion effort (ANP) that was awarded after about 30 billion had been spent. He predicted that space power could be equally as costly, but if an agency continued the funding, many of the difficulties experienced in the ANP program "could be solved before they became serious."

U.S. Officials Split on Revealing Soviet Space Failure Information

Washington—Debate within the U.S. government over how much it should reveal about failures in Soviet Russia's space program continued last week but the indications were that the long-standing policy of reserve would stand.

The U.S. Senate first action last Sept. 5 to announce that Russia had had five failures and one partial success in its attempts to send probes to Venus and Mars (AW Sept. 13, p. 34). But top government officials still were refusing later last week to let the National Aeronautics and Space Administration publish details of the status of the Russian probe launched on Sept. 1. Earlier, NASA was allowed to publish orbit details on the Russian Venus probe which failed on Aug. 25. Fragments of that vehicle fell from orbit on Aug. 28, Aug. 30, Aug. 31, Sept. 1, Sept. 5 (two pieces), Sept. 6 and Sept. 8.

Information on the Russian failures was released by NASA Administrator James E. Webb in a letter replying to a request from Sen. Robert S. Kerr (D-OK), and Rep. George P. Miller (D-Calif.), chairman of the congressional space committee, for "use in documentation" on Soviet planetary probe failures. It is believed that the White House added the exchange of letters. Webb's letter gave these details:

- Russia used a two-stage launching vehicle for each planetary shot. Three stages were used to put the payload and a trajectory-injection stage into a parking orbit, and the injection stage was to be fired once after one pass around the earth.
- In such case, "the probe would have arrived at Venus or Mars with too high a velocity to have been captured around either planet" if the landing had been successful—indicating it be attempted similar to the U.S. case.
- Five failures were caused by "rocket vehicle malfunctions."
- Attempts to launch a probe on a 730-day trip to Mars on Oct. 10, 1963, failed before a parking orbit was achieved.
- Second Mars shot on Oct. 14, 1963, also failed to reach a parking orbit.
- What the letter called "the first attempt to send a spacecraft to Venus" on a 105-day flight was made on Feb. 4, 1964. The vehicle reached parking orbit "but could not be ejected into its planned Venus trajectory. The Soviet Union announced the launching as a successful earth satellite, Sputnik 7, and claimed for it a new night in orbit record of 14,000 hr."
- Venus probe launched Feb. 12, 1964, reached the vicinity of the planet in 97 days but the radio transmitter or power supply apparently failed when the probe was about 45 million mi from earth.
- Venus probe launched last Aug. 25 "apparently could not be ejected from its parking orbit. That this shot had been successful, the probe would have arrived at Venus on about Dec. 7, 1963, and the U.S. "Mariner 2," which was launched Aug. 27, Webb's letter said. "It appears that the normal flight time of 112 days for this shot was substantially shortened to 104 days by strengthening structural weight," the letter said.
- Shot on Sept. 1 successfully placed a vehicle into parking orbit but the payload could not be ejected.

Labor Talks Snagged On Union Shop Issue

Washington—Despite men allowing majority to vote on a union shop deal, locked labor management negotiations at four aerospace firms last week and parked President Kennedy to the face heat of the controversy.

A special board of conciliation failed to break the impasse and recommended to the President that the companies in which shop deals were stalled should allow a union shop if their employees approve it as a two-thirds vote. The companies are North American Aviation, Lockheed Aircraft, and Ford Co., negotiating with the United Auto Workers, General Dynamics and Lockheed Aircraft, negotiating with International Union of Machinists.

A union shop requires that an employee cannot be hired unless he agrees to join the union within 30 days. John E. Casper, Lockheed vice president, opposed any vote on the union shop, declaring, "Our opposition to the union shop is long standing and is a key part of our company's basic business philosophy."

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The board's vote recommendations are not at issue, although union spokesmen said they are less than they want. The board recommended wage increases of 5 to 8 cents an hour in 1963, 6 to 8 cents in 1964, and 2 1/2% of the top rate of each job grade in 1965.

Astronaut Group Picked

Near selected candidates have been selected by National Aeronautics and Space Administration, which expects to announce their names this week. Two are civilians and the others were from USAF and Navy.

This is the first of a regular selection process which NASA will conduct every 12 years to have a pool of about 30 candidates for the first Apollo mission before in 1968. New group will form the eighth pool for training for Gemini mission, in which the Mercury astronauts will be pilots.

The new group of pilots was selected Sept. 16, but NASA delayed announcement of their names because of President Kennedy's loss of the agency's installations last p. 103.

Scientists Briefed on New Radiation Level

By Philip J. Klaus

Washington—Two-day secret briefing on the details and implications of the intensification of the natural Van Allen radiation belt which resulted from the July 9 high-altitude nuclear explosion was given here last week to several hard industry and government scientists.

The briefing, held at the Goddard Space Flight Center, was sponsored by the Defense Department and the National Aeronautics and Space Administration.

The unexpected long-term intensification of the Van Allen radiation belt (AW Sept. 30, p. 35), which now last for many years, is believed to create primarily of high-energy electrons with energies of several million electron volts (MeV) at altitudes above 300 mi.

The increased radiation will require the use of added shielding for satellite solar cells and is expected to alter use of new radiation-resistant types of cells. These include "N-type" type silicon cells, in contrast to the widely used "P-type" type, and gallium arsenide cells which are even more radiation-resistant.

The principal hazard of the intensified radiation to manned spacecraft is to solar cells which are fully exposed. The spacecraft still provides some protection for instrumented payload which might otherwise be subjected to radiation damage. However, electrons with energies of one million electron volts can penetrate about one-third of a

centimeter of aluminum and one-half centimeter of water. At higher energy levels, electrons impinging on the spacecraft shell could produce X-ray radiation which is not known as the bremsstrahlung effect, i.e., "braking or slowing."

The altitude at which the increased radiation has occurred can be deduced from the initial penetration of the satellites which have been launched only by the July 9 nuclear test. Transit 8B and TRANSAT have apogees of about 600 mi and perigees of about 590 mi. Atlas has an apogee of 733 mi and perigee of 710 mi. Transit 5, with apogee of 695 mi and perigee of 568 mi, has not been altered. However, one of its television cameras failed shortly after it went into orbit, giving a surplus of electric power which would allow a significant degradation of solar cells before it would go out.

The Bell System's Teletex communication stations, placed in orbit with an apogee of 1,560 mi and perigee of 1,571 mi (the day after the July 9 test), may not be less seriously affected by the increased radiation. This is attributed to the fact that it is the only satellite to use the new radiation-resistant N-type type of silicon cells and to the conservative design which provided a surplus of electric power capacity.

The intensified Van Allen radiation is expected to affect the Soviet reconnaissance satellite, which generally operates at low altitudes of several hundred miles. However, the Soviet

early warning satellite which operates at altitudes of about 1,000 mi can be expected to feel the impact.

Industry has been slow to adopt the new "N-type" type silicon cells, originally developed by the Army Signal Corps. With little demand, the cost of the newer cells has been higher. But in comparable quantities they should be no more expensive, and perhaps less expensive, than previously used on P-type type silicon cells.

Tests conducted by Radio Corp. of America on the newer N-type silicon cells indicate that they undergo about one-third the degradation of conventional cells from proton radiation and only one-fourth the damage when exposed to electrons.

Even more promising are solar cells made from gallium arsenide, which appear to be roughly ten times more resistant to radiation than conventional silicon cells and about three times more resistant than N-type P-type silicon cells. These figures are based on limited measurements to date which are continuing.

Gallium arsenide cells potentially have a 100% higher conversion efficiency than silicon cells, although tests on small models have shown they are inefficient. An RCA subsidiary has the company has produced gallium arsenide cells with efficiencies as high as 18%, compared with a figure of 10% which is best achieved for silicon cells.

At present the cost of gallium arsenide cells in experimental quantities runs between \$175 and \$575 per cell, compared with about \$5 for equivalent size silicon cells. In quantity production, gallium arsenide cell cost is expected to come down to about \$20, still considerably higher than for silicon. The materials' higher cost results in part from the fact that it must be carefully produced and purified in a compound semiconductor material.

However, a promising difference between gallium arsenide and silicon is that a two-stage solar layer of the former can absorb as much solar energy as 100 silicon thick layer of the latter. This suggests that it may be possible to fabricate gallium arsenide cells by means of conventional thin-film techniques and thereby that not significantly, according to an RCA spokesman.

All types of solar cells are made less valuable to space missions by protecting them from supplies in space is difficult. For example, the Atlas 5, Transit, which was protected with 30-mil thick supple, experienced a drop of only 5% in current output during the first two weeks, while similar test cells



North American T2J-2 Makes First Flight

Five of two prototype North American T2J-2 trainers in shows during first flight recently at NAA's Columbia, Ohio facility. Aircraft is in two engine version of the Navy's T2J1. Changes to two-engine configuration was made under \$1.3 million. Navy modification contract to evaluate performance, safety and timing capabilities of a two-engine trainer. New model is powered by two PW 300s of 3,000 hp, three each. T2J-2 had a single Westinghouse TDW303 engine of 1,400 hp. Source: NAA says two T2J-2s will cost less than a single T2J1.

protected with 20-mil supple experienced a 10% drop.

However, shielding should also reflect more sunlight and therefore reduce the output of solar cells. Also, most types of shielding material become degraded when exposed to radiation, which further reduces solar cell output. Extensive tests to evaluate the effect of radiation on solar cells and shielding material are under way in a number of experiments including RCA and the Naval Research Laboratory.

Based on theory and the results of the Project Argus experiments of several years ago, the July 9 nuclear detonation was expected to produce a temporary

artificial radiation belt below the lower fringe of the Van Allen belt. A pool of electrons contained in the White House last spring, including Dr. James Van Allen, concluded that the artificial radiation would disappear in a matter of weeks or months.

Dr. J. Fred Seeger appears to have been closest to predicting the long-term intensification of the natural Van Allen radiation in a paper written in May and submitted to *Nature Magazine*. The warning the possible consequences of a high-altitude nuclear explosion. Seeger said that "intense effects can be produced (in some cases) which can last for years, possibly because of the presence of the earth's magnetic field."

At the time Seeger was a member of the University of Maryland's Project Argus, working without access to classified details of the planned high-altitude blast produced the manner of a thin shell of electrons with energies of two million electron volts as well as a thick belt of low-energy particles. Can this be described as the "Weather Bureau's" current weather satellite center. It pointed out that for a radiation belt of high altitude, near the equator, most of the electrons and protons produced by the explosion would be trapped by the earth's magnetic field, particularly if they hit the lines of the earth's magnetic field with a sufficiently high pitch angle.

If there were an atmosphere and the earth's magnetic field were perfectly formed, the particles would stay trapped forever. In practice these idealized conditions do not exist so that the particles in time are scattered and released into the lower atmosphere. Particles in the stream of the equator, where the earth's magnetic lines of force curve to the

highest altitude, will cross the longest. The length of time which electrons and protons will remain trapped can be calculated, but it is a "rougher than rougher problem," Seeger said, based on knowledge available to him at the time. Presumably the results of the July 9 test have added new information which will make it easier to predict the results of one known test.

LOH Emphasis

Washington—Cost-Avoidance evaluation for LOH (Loss of Human) is a light source. Vision class helicopter may be making and greater emphasis may be placed on larger class of rotor wing aircraft, cutting the impact to protect themselves and complete their mission smoothly.

Though he qualified it as a personal opinion, Maj. Gen. William B. Bunker, commander and director of operations, Air Force Materiel Command, told in American Helicopter Society group here that he favors a "dramatic improvement for low helicopters in the Air Force."

Gen. Bunker emphasized the importance of low helicopters in 10-12 place aircraft, the size of the Bell HU-1D Huey, and predicted a larger improvement for 12-15 place and 16-18 place aircraft from helicopters with the necessary development. He said the Army would be making light helicopters in proportions and higher helicopter types.

Another man showing 12-15 place of the Huey budget will grow to 25-30% more, Gen. Bunker said and eventually to 25-30%. The Army headquarters will look to company-sponsored developments, he said, where the manufacturers have handled the development and the Air Force has the end use.

Glenn Radiation Dose Unexpectedly Low

Washington—Alec J. Cal. John H. Glenn, Jr., reported last week that the heavy proton cosmic radiation dose expected during his 4 1/2 hour flight on Mercury Atlas 14, according to Dr. Hansman J. Schaefer of the Navy's Biological Research in Personnel.

Gamma ray experiment conducted on board Glenn's capsule shows a total of 170 heavy proton ray strikes over an area of 600 sq. in. It had been estimated that at least 2,000 strikes would be recorded on the remaining plane. Expected rate to the astronaut would be 1.4 strikes per sq. in.

Dr. Schaefer believed that spacecraft with and capsule instrumentation showed more of the error and kept the total dose less than expected.

Atlas flight was made at an orbital inclination of 31.9 deg. between the altitudes of 97A and 238B. It carried National Aeronautics and Space Administration balloon flight (AW Aug. 5, p. 18) indicate a strike rate of 50 per sq. in. for cosmic protons heavier than iron. Dose of 157 strikes was recorded for all heavy cosmic protons.

Radiation experiments were relatively unaltered, and was made at 53 deg. latitude at an altitude of 136,000 ft. Very low heavy cosmic proton intensity recorded below 10,000 ft. Coated photo at Cape Canaveral during the flight showed no heavy cosmic ray tracks.

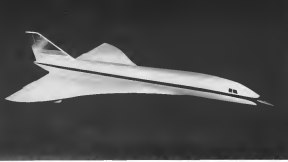
Objective of the mission was to determine the effect of the rays on man and his equipment.

In the Glenn flight, four radiation tracks, each containing eight plates, were carried inside the capsule pressure vessel. One was damaged in processing, leaving a total target area of 400 sq. in. for counting.

New High-Altitude Tests

Washington—AEC will conduct new high-altitude nuclear test from Johnston Island to obtain additional data on the unexpected effects of the July 9 high-altitude blast, which produced a long-term intensification of the high energy electrons in the natural Van Allen radiation as well as the expected temporary, lower altitude belt of low energy protons. The restricted area around Johnston Island will be re-established of tests Sept. 22.

The new tests, sponsored by the Atomic Energy Commission and the Defense Department, are expected to have smaller risks and to be conducted at different altitudes, probably about 300 mi. To prevent further intensification of the Van Allen radiation. The July 9 blast, which occurred at about 300 mi altitude, had a static of one megaton. AEC and DOD also announced plans to test more from Johnston Island, including five days of nuclear outbursts.



ARTIST'S IMPRESSION of the proposed Anglo-French Mach 2.2 supersonic transport points up delta wingplan and swept tail. Windows are positioned along side leading back. Front windshield is covered by retractable housing.

Key Decision Near on Anglo-French SST

London-British and French governments will make a key decision late this month whether to proceed with joint development of a Mach 2.2 jet transport by a consortium of four firms.

The decision will be made at a meeting between British Minister of Aviation Julian Aveyar and French Transport Minister M. Dumasch in Paris.

Meanwhile, evidence of the extreme technical feasibility already laid for the project by British and French firms was shown at the Farnborough air display. Detailed design of the modified delta-wing transport aircraft has been completed by a joint Sud Aviation-British Aircraft Corp. team headed by Dr. Angier Russell of Bristol Aircraft.

Considerable engine development is under way by Bristol Siddeley, working with Snecoma in France on the Olympus 593 engine with about 13,000 lb. maximum thrust.

The Anglo-French supersonic transport will be built in two versions—medium range (2,300 mi.) and long range (3,500 mi.). Both versions will use the same basic airframe featuring wing modification of the delta-wing air rate fuselage and 110-passenger capacity.

The only difference in the two models will be use of the cargo hold in the fuselage to carry additional fuel for the long-range model. Sud will build the medium-range transport in its Toulouse plant, and Bristol will build the long-range version at Filton.

The ultimate design team will be headed for two years by Dr. Russell, who will then turn it over to his French counterpart, Fernand Sarrat. The team is now working on splitting the specific airframe development work between BAC and Sud.

Meanwhile, Bristol Siddeley and Snecoma have split the engine development program 50-50, with Bristol Siddeley responsible for the major share in the rotating area of the engine. Snecoma will do its work on variable intake and variable nozzle design and environment.

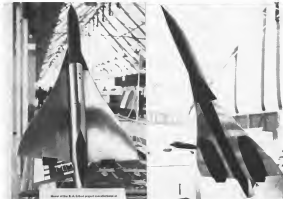
Anglo-French combine also will form

a joint task force for sales and production with duration heads alternating every two years. Heads of these divisions will not be appointed until after the synchrotron meeting clarifies the future of the project.

Farnborough offered considerable evidence regarding the research foundation already laid for this project, with wind tunnel design and for intensive testing in Bristol Aerothermal Establishment and French wind tunnels, plus the Olympus engine already operating on an Avon Vulcan being tested. The engine is in its TSRL2 military version. Low-speed handling characteristics of



MODEL OF BRITISH-FRENCH MACH 2.2 transport was displayed at Farnborough. Aircraft would be built by British Aircraft Corp. and Sud Aviation, with joint government backing. Four Bristol Siddeley Olympus 593 engines are joined in pusher below wing.



TESTS AT MACH 2.2 PLUS speeds have been made by Bristol Aircraft Establishment at Farnborough on this model of the joint British-Snecoma transport. Tests were made on the RM 15 H X 8 H supersonic tunnel. Bottom view shows detail of engine intake, which will employ variable geometry to run over flame.

Tupolev Gets Farnborough VIP Treatment

London-Tup. design director Andrei Tupolev paid his own way into the Farnborough air show, but now, surely got VIP treatment from British Aircraft Corp. executives as none as he was recognized.

Tupolev bought tickets at the gate because at the Ministry of Aviation has no existing Russian guests to the private showings, pending invitation to visit Russian plants (AW Aug. 21, p. 31).

He was accompanied by his daughter, Tatyana, Eugene A. Smerov, Avialet's general manager in London, and A. G. Pavlov, of the Soviet Embassy staff here. He was accompanied by a member of the BAC design team who saw the party outside a dining rooming the Tupolev VC-10 four jet transport.

St. George Edwards, BAC managing director, who was inside the VC-10 at the time, immediately invited Tupolev and his party inside for a tour conducted by himself and Keith Byrne, VCHH chair test pilot.

During the tour, Tupolev mentioned the Russians were building sub-orbital jet transports (AW May 28, p. 41), and showed considerable interest in engine instrumentation and control placement. The Tupolev party was later entertained at lunch in the BAC canteen in which St. George described in a pretty good command.

IATA Plans Czar to Enforce Rate Levels

Plans call for staff of 50 criminal investigators; three-man enforcement group has failed to halt rate cuts.

By Robert Hitz

Dubai—Draconic action to fight cut-rate ticket selling was taken by the International Air Transport Association at its 19th Annual General Meeting here last week.

Action to appoint a single enforcement czar backed by a staff of 50 investigators "trained in criminal investigations" was taken after a heated meeting of the IATA executive committee in Killiney during which evidence was presented indicating that the three-man IATA enforcement group was functioning but failed to stop the spread of discount ticket selling below the IATA rate.

The executive committee heard a blistering report from Dr. Matthew Stannard, IBOAC chairman, on experiences of the five-man investigating team in action to stop discount tickets from IATA member airlines. Dr. Stannard estimated the cut-rate sales falling below cost IBOAC airlines in revenue during the last year.

Dr. William Hildred, IATA director general, said price cutting was particularly bad in the Middle East where discount market place buying had unfortunately been adopted in airline ticket sales.

He said there have been cases even in the last year where companies \$25,000 have been levied against IATA members for deliberate underpricing of tickets. However, delegates to the meeting have indicated the use of discount ticket selling was spreading westward and was already prevalent in Rome with several of the most recently proved violations occurring in Frankfurt. Dr. William noted that the cargo field in West Germany had also been trouble some on rate enforcement.

Delegates consensus upon to the Annual General Meeting noted "it is

fully evident that some members have low and less scrupulous about cheating traffic conference resolutions and the effects of this lack of scruple are quite evident."

Discount selling is so prevalent in some parts of the world that no company gains a single dollar by it but only suffers in rebelling itself and let low calculation of a large percentage of the fleet approved by themselves and their governments.

Dr. Hildred said, chairman of Quanta Airlines and former IATA president, noted as he had earlier addressed that "our \$5 million passengers never had it in good with airlines; such discounts available worldwide. When some of these checks should with broad grants there is plenty of room to stretch out across the capital state in our lovely new airports."

"The airline passenger, the non-IATA operator, and I regret some of the agents and IATA members have ordered that their hands in the industry's life during the year at a time when revenues are low. It is not possible for any member that a system of honor is the best method of raising on our business that I hope he will come forward with the idea in the next traffic conference so that the position can be cleared."

Executive committee of IATA, headed by J. G. Givens, chief executive of South African Airways, said the new IATA enforcement committee, which will replace the Tokyo rate enforcement, will have full authority to raise rates and assess fines up to the maximum \$25,000. The decision will be subject to the approval of the executive committee only on grounds of gross evidence. This committee will hear cases immediately after charges are made in contrast to the present Executive Committee that takes the case to the public and then to the airline rate rule.

Person IATA enforcement staff of 24 agents will be doubled and the annual enforcement budget of \$500,000 will be increased substantially. Dr. William said the new enforcement would be required to hire a thorough background in airline rate structures, legal experience, and a reputation for absolute integrity.

Dr. William also noted that if the maximum fine of \$25,000 proved ineffective, IATA had the power to request members for reported frequent violations of its regulations. IATA members were also warned by the executive committee that they would be responsible for actions of their non-IATA affiliates.

IATA Meetings

Rome will be the site of the 19th International Air Transport Association meeting next fall with Alberto Rizzo, Airlines secretary in Rome, Republic, Colombia, expected to be in line for the 19th meeting of the transport association.

There were several reactions among delegates to the new IATA enforcement proposals with some indicating it was unrealistic to worry about discount selling from a police viewpoint when the real issue was power law level. One airline delegate, however, stated that the proposed policy of IATA officials to hold the price line, told the meeting "Well, my airline won't be the first to break the line but I guarantee you it won't be the last either."

Basic issues posed by the spread of discount ticket selling during the past year of jet transport overgrowth, and airline financial losses will arise as the basic traffic conference scheduled to open Sept. 24 in Chicago, here.

Other delegates and they failed to note any real distinction between the discount ticket selling practices and the discounts being offered (insensitive to the airline under the so-called passenger group charter plan).

Apparently accepting the technical unsoundness of the expensive transport, IATA delegates desired considerable debate during the meeting to formulate any program to minimize its consequences with the same thorough detail that its technical committee was studying design. Delegates agreed that operating costs of the expensive transport should be equal to lower cost jet transport but appeared to be huffed on how adequate economic conditions can be found for expensive transport performance.

Schuch, an executive ally of the large airline atmosphere of the Annual General Meeting, was dismissed negatively with the warning that traditional 10th two of facilities per hundred million passengers make him no longer had any significance for the airline public and that the airline rate rule a strange stand in fighting for adequate safety standards.

Dr. Hildred said he told the audience "I note that the passenger safety rate per hundred million passenger kilometers as scheduled as airlines has remained 10th better than constant over the past 10 years (AW Sept. 10, p. 17). The figure for 1964 was only slightly better than 0.77 percentage in 1968. There are no figures available yet for 1962. But on indicators I do not think there will be much change. However, as volume of flying is increased, the number of fatalities increased and the passengers are

becoming increasingly sensitive to the position. In this year there have been a number of unfortunate accidents and I wish to make the point that if a rate group is high but as to the safety factor per passenger carried is as good as ever. I suggest we should set a target of halving our present rate in 1963 and direct your best efforts to how that can be done starting with a careful analysis of reasons for all accidents over the past two years."

Release Children, Irish member of transport also argued the IATA delegates to "greater devotion to the problem of safety." He stated there is no reason why it is impossible to make the road safety there should be such the small number of accidents to "small aircraft."

Lead spokesman of TWA, passenger which was also stated to compare a view of the airline to present an airline's view of their activities, asked if public confidence in flight was waning. "If so it is the operator's fault to want to lead their craft to the maximum with consequences of low flying and high speeds. Modern practice of taking off

and landing at 140 kt is basically unsafe however many times you do it without accident."

Lead spokesman also stated the false security of safety statistics, pointing out that if the present fatality rate per hundred million miles flown step continued, the industry as a whole will produce 10,000 passenger fatalities a year by the end of the century with a crash occurrence rate of one per 100,000.

Lead spokesman noted the IATA charter called for promotion of regular and commercial air transport and charged sharply that the air transport industry had failed to do this. "That is why it is helped by governments in facilities provided in building of aircraft with complete control internationally at home, should be given a financial mass security, should be given a complete freedom of the ordinary man in the street. In ordinary business such results would not be tolerated. I know we are all together to fight but the world has always suffered from the intellectual and moral confusion has had none than this."

CAB Divided on Foreign Carriers

Washington—Civil Aeronautics Board's long-standing desire to play a more active role in international air transportation within a ceiling on open air between staffed Board members who advocate the principle of protectionism, and a group of six members who favor an "open skies" policy that might be more adaptable to changing world conditions (AW July 16, p. 42).

The CAB's executive committee of a Board proposal to require more uniformity in scheduling data from foreign airlines (AW July 1, p. 36) came as a surprise to some of the airline industry and brought a highly visible objection from the Board's Economic Committee Regulation (ECR). The Board has been involved in a running battle with the United States has conducted for a number of years with many foreign carriers over the issue of capacity and route rights.

The issue first taken by Executive Edward T. Stodola in the current Foreign Air Carrier Permit Review Review is that need for the regulation change is not great and if granted, would result in control of foreign airlines which could sink against over-all U.S. policy considerations. The case is now before the CAB and may be decided by the CAB with the next few months, subject to final approval by the President.

Outcome of the case, authorized otherwise, will depend largely upon a general United States attitude toward the now engaged in writing a language

policy for various airline agreements. ECR's rejection of Stodola's recommendations, in support of Board Counsel J. F. McKenna, is being raised by supporters of the CAB proposal in the last, most authoritative body of the CAB, the full CAB.

McKenna contends that the evidence, rather than rule on whether the regulation change (AW July 1, p. 36) is justified, is a matter of policy. In favor of providing CAB with more information, instead "substantiated his own foreign policy need" and was "preoccupied" with the thought that the case would be decided by the CAB. The CAB's rejection of Stodola's recommendations, the attorney charged, that these actions would reduce foreign policy, involved the CAB's role in foreign policy and would be a "dangerous intrusion" into the hands of the Board.

In denying the need for any regulation change, the executive "inhibited the evidence" by constructing a bogus case whose components were overreliance, unilateralism, common market, balance of payments, balance of trade, U.S. foreign policy, etc.," McKenna said.

He "moved away from the case before him" and substituted his own foreign policy needs for the case. It is the Board member's duty to let CAB's responsibilities into foreign policy, he said.

Trident Appearance Thwarts IATA Ban

Dublin—British European Airways said the de Havilland Trident aircraft combined to thwart a three-month International Air Transport Association ban on manufacturers' sales activity at the Annual General Meeting here where they displayed the Trident tri-jet transport.

Leading passengers are still flying experimental, although they are permitted to IATA meetings and have by de Havilland Test Pilot John Cunningham and Peter Bristow. The Trident first arrived in Dublin Sunday evening, Sept. 8, bringing a load of IATA delegates from London, including the IATA contingent headed by Anthony Midland, general manager. The Trident arrived in the de Havilland field at that field first equipped in Dublin during testing sessions of the Annual General Meeting by a closed group of demonstration flights for delegates.

Only one IATA delegate opposed for the first scheduled demonstration flight and had neither feared conflict of the first. That was the fact that aircraft manufacturers had attempted an sales promotional activity during an Annual General Meeting using the IATA executive committee has imposed shortly after the Tokyo meeting in 1964.

At that time, Dr. William Hildred, IATA director general, wrote the Society of British Aeronautical Engineers, American Airlines Inc. and the French aviation industry's organization, telling them to request that their members stay away from IATA general meetings.

United States manufacturers representatives however on the sidelines of the Dublin meeting were informed by what they regarded as "de Havilland's strategy" to evade the IATA ban.

SEA bluntly pointed out that there was no IATA ban against an airline doing starting its own equipment to follow delegates. The Trident appearance in Dublin may set a precedent for airline manufacturers to use to increase active sales promotion at the next IATA Annual General Meeting in Rome.

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The James M. Smiths

New York—Eight additional helicopters, several of which might be Sikorsky SH-60s, will be needed in New York Area as for service removed from the rooftops of the Pan Am building and the World's Fair heliport here, officials of the agency say.

Fast Air mail operation will bring an expansion of existing schedules, meaning a need for two more aircraft. A high-frequency service planned for the World's Fast, which will be open for two six-month periods in 1964-65 will require six more units.

¹ We plan to provide 30 million seats for World's Fair traffic during each of the Fair's two periods of operation," said Robert L. Casper, Jr., president and director of New York Airways. "This is based on a proposed schedule frequency that would provide flights every 2-3 minutes, and, possibly."

The airline now operates three Vertol 107 turbine helicopters. A fourth is scheduled for delivery in November and a fifth in January, 1967.

Although demons with intricate textures are still going on, current thinking on the best expansion is slanted toward their more Virtual and less S&N. However, Cunningham cautions that the additional chapters will not be obtained through standard purchase or lease arrangement.

"In our discussions with the manufacturers, which are well advanced, we have had to tell them that in consideration of our outside situation, we can-

On the other hand, Carraways and New York Airway don't want to keep slacking profits may come from the increased traffic expected to result from

New York Airways feels that bids reflect operating to and from the Far East for their operations through an increased high load factor.

"We'd like to obtain the needed insurance for the operation on a modified lease-purchase arrangement," said John E. Callagher, vice president.

New York Airways might also obtain one or possibly two, 5-61Ns in addition to the six it fleet will be acquiring shortly, for service to the line. Galagher believes at least two additional aircraft will be needed for operations from the Pan Am building, and the

SOIN's 28-passenger capacity, three more than the Vertigo, would make it a good suit for this operation.

Sikorsky has plans to build four S-61Ns for which orders have not yet been placed. Two or three of these new assets likely to be ordered by Pakistan International Airlines (AW June 4, p. 41), for which New York Airways has made a prospective operations study. New York Airways could pick up any of the four Pakistan does not order.

In its approach to Ventral and Silents, New York Airways is playing hard on the promotional aspects of the fare. It feels both manufacturers would like that helicopters prominently demonstrated to fare carriers through scheduled service.

Veritol officials said they received the proposal from New York Airways, but have made no decision yet.

Enter helicopter service plan for the far longer on rooftop operations. Canteens and Gallagher both are confident that New York Airways will be operating from the 300th Pan Am building and the 120th Wadsworth for restaurant help-out well in advance of the bar's opening in March, 1964.

The lot site will be approximately 4 mm from the Pan Am roof to help collect wind-blown rain from suburban points such as northern New Jersey. Coverings was the one-way link from the Pan Am building will be \$10 one-way and perhaps \$15 for a round trip.

"We also cannot serve from Trenton, N. J., Paterson, N. J., New Haven, Conn. and other nearby cities of similar size," he said. "And there's no reason why we can't be in the Philadelphia market in the near, far, or long."

The Port Air pool is expected to become a shuttle pivot: the passing point for Seaboard's flying a high-frequency, schedule pattern between the Port, La

The Port of New York Authority is building a \$1,100,000 elevated rest area at the fair stop which is the last rest with a 150 x 700 ft. landing deck.

Port Authority has made New York Airways responsible for helicopter non-

Gallagher said the Federal Aviation Agency has now authorized New York Airways to operate from the Pan Am building with a 15,000 lb. gross limit.



INTAKE SCREEN designed by Vortel to prevent ingresses such as flat which caused two fatal landings of Vortel LIFs operated by New York Airways is shown installed. Screen is 4-in. stainless steel mesh and effective debris has yet to be developed. The device reduces engine power by 30-12 dips, slowing approximately 40 ft/sec at Vortel's rate of climb at 1,000 ft.

tion, which is 1,000 lb under the Vortell's maximum ability.

"Tests are now under way to up this to 27,000 lb," Gallagher said, "which is what we'll have to have to make the operation practical. Approval for 17,000 lb is expected before we begin living off the land."

A 16,000-lb gross lift would restrict New York Airways to carrying only 15-16 passengers on and off the Pan Am building, whereas the Vertol has seats for 25. Figuring 300 lb per person, the 17,000-lb gross lift would permit carrying 20-21 persons.

Gallagher and the 17,000 to grow figure will come through strengthening the Virta's leading grow parenting leadings at increased rate of descent and business the shift homewards and

CI allows us that we now modify the engine to raise its rating from 1,750 shp. to 1,400. The higher power engine, complete with FAA certification, is expected to be available in the latter part of 1963.

Another problem of rooftop operation—that of turbulence air over the loading area, appears solved through special features toward both the Pan Am and World's Fair exhibit goals.

Carved "cups" which round on the otherwise sharp bend between the roof and building wall, have been installed on both structures. The cups bend up turbulent currents and provide a smooth laminar air flow extending 35-40 ft above the leading edge.



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Long-range research enables Purolator to anticipate — and meet — the evolving needs of the aircraft and missile industry. During the 30+ years, Purolator invested nearly \$7 million in engineering research and development — now operates the nation's newest, most-advanced filtration research center at Rahway, New Jersey.

Following are just three examples of how Purolator research and engineering skill succeeded in fulfilling some unusual aircraft and missile filter design requirements.

FREEDOM FROM BUILT-IN CONTAMINATION: In order to eliminate contamination possibilities afforded by conventional welding, brazing, or soldering, Purolator designed a filter for the hydraulic systems of Lockheed C-141A and F-104G jets in which the filter elements, caps and center tubes were pressure-tested together.

The filter element is composed of 20 square inches of convoluted stainless steel wire cloth. Flow capacity: 4 GPM. Nominal filtration: 10 microns. Maximum differential across assembly: 10 psi.

ABILITY TO OPERATE UNDER PRESSURE AND TEMPERATURE EXTREMES: A Purolator jet fuel filter used by

Boeing's 853-G bomber and KC-135A tanker is especially designed to operate efficiently at extremely high temperatures and in a temperature range of -55°F to plus 250°F.

The convoluted stainless steel wire cloth filter element contains 360 square inches of filtering area. A suspended spring action differential indicator shows when the element becomes clogged and pressure drop across the element increases to a pre-determined figure.

MINIATURIZATION: This design requirement is well illustrated by a Purolator filter used in the hydraulic system of the Hawk missile.

The filter measures only 1" x 5/8". Weighs one ounce. Yet it has a flow capacity of 2 GPM. The wire cloth filter element contains nearly 1,000 feet of stainless steel wire and is convoluted to give 4.2 square inches of filtration area. Nominal filtration: 10 microns. Maximum operating pressure: 2,500 psi. Proof pressure: 3,750 psi.

Extensive requirements of aircraft, missile and other highly advanced industries are becoming increasingly sophisticated and demanding. New filter media today provide degrees of filtration as high as 1 micron — where 10 microns are considered the absolute a decade ago.

If you have an unusual filtration application, write us about it. As the world's largest, most-experienced manufacturer of filters, Purolator has the research, engineering, and manufacturing facilities to help solve your problem.

Filtration for Every Known Field

PUROLATOR

PRODUCTS, INC.

Rahway, New Jersey and Toronto, Canada

Aircraft Evacuation Measures Formulated

By David H. Hoffman

Washington—Federal Aviation Agency, U.S. aircraft manufacturers and the airline industry are moving agreement on a long list of modifications aimed at enhancing passenger safety when turbine-powered transports are involved in survivable accidents.

Numerous modifications, each reflecting common sense, will be implemented voluntarily by the carriers. Others soon will be the subject of formal FAA mandates. All are designed to speed the evacuation of passengers from an aircraft crippled on the ground, especially when its cabin fills with smoke and carbon monoxide.

Meeting here last week, a panel of seven government and airline officials discussed the modification program's first phase, which entails making emergency exits more conspicuous with improved signs, lights and lighting. First aircraft to be modified for evaluation purposes are a Boeing 707 and a Lockheed L-1049 Super Hercules, both owned by Delta, a Boeing 707 and a Lockheed L-1049 Super Hercules, both owned by Delta, a Boeing 707 and a Lockheed L-1049 Super Hercules, both owned by Delta.

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Denver Crash Studied

In the June U.S. airline crash which killed 133 people and injured 100, the FAA is studying the crash to determine what went wrong. The crash occurred on June 11, 1971, at 16:12 hours, on a flight from Denver to Los Angeles. The aircraft, a Boeing 707, was on its final approach to Denver when it crashed into a hillside.

According to the study report, which was written by a three-man team of technical experts at FAA's Civil Aircraft Division, Research Institute, cabin emergency preparation accounted for all fatalities. In addition, those who died were passengers in the DC-8's front section where one emergency exit was not used in the crash.

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should be equipped with latches able to withstand high g forces.

• Making emergency exits and installation of escape ropes. A rope at least 2 in. wide that contrasts with the color of an aircraft's interior, emergency exits on the exterior skin of its fuselage. In addition, emergency exits of its fuselage must be capable of being opened by one person to the ground from either the leading or trailing edge of the wing, whichever is farthest from exit.

• Interior emergency lighting and "no smoking" signs. The FAA is studying the crash to determine what went wrong. The crash occurred on June 11, 1971, at 16:12 hours, on a flight from Denver to Los Angeles. The aircraft, a Boeing 707, was on its final approach to Denver when it crashed into a hillside.

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longer than 24 in. as weighing more than 5 lb. on board, every aircraft under review includes fasteners, pins, rivets that it later agreed to study on next steps, rules governing access on luggage before, during or after the flight.

FAA's study of the United DC-8 accident at Denver, attempting to avoid the 67 instant passengers could not evacuate the aircraft through a single exit, and that instant failure should be eliminated. The first rule is the width of aisle, the aisle width is 15.5 in. as opposed to 22 in. in the first-class forward cabin.

The carrier's rule, the study showed, meant that the passengers had to stand in single file with their backs to the exit, not at the rear of the cabin.

View Blocked

The study also stressed that there was no emergency exit, but a small, single exit, a floor-to-ceiling partition, which impeded the two persons, made it impossible for them to see escape route in the first-class cabin. No person on the right side of the partition, the study showed, could see emergency exits available in the forward section of the cabin.

Because of aisle width, the study concluded it was "certainly impossible" for cabin attendants in the forward section to move forward, thus to assist evacuation of the single-filed cabin. In addition, the study and an emergency evacuation briefing was given the passengers prior to the accident, and that briefing was not repeated.

Against this background, the study recommended that:

• Passengers in emergency evacuation conditions plan to any landing which could be complicated by a known obstruction.

• FAA undertake a comprehensive review of emergency evacuation procedures to assess the probability of required breathing or light to determine whether exits should be reduced in high density areas.

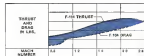
• Plans be passed in transport about to segment all passengers with the location of emergency exits in other parts of the aircraft.

• Research be initiated on how to fasten passengers with mechanical fasteners, as for the opening of the emergency exits, a training device.

• Regulations governing the number and location of exits in transport aircraft be reconsidered in terms of aisle width, passenger capacity and cabin configuration.



Have you looked at the F-104's thrust-over-drag curve lately?



As you can see by the chart at left, the F-104's drag doesn't equal thrust until Mach 2.4. The area in blue indicates the available reserve thrust.

This reserve thrust gives the F-104 tremendous extra power for supersonic acceleration, supersonic climb, and supersonic maneuvering. The F-104 can accelerate from Mach 1 to Mach 2 in two minutes. And the F-104 can maintain Mach 2 through a 3.3G steady

static turn even when carrying wingtip Sidewinders.

But extra thrust isn't everything. Versatility is important, too: the ability to carry a variety of external stores and internal electronics, including the most advanced all-weather systems. Maintenance is also a big factor. Recently a USAF squadron in Germany flew 836 hours and 5 minutes in one month — with only 12.4 maintenance man hours per flight hour.

The F-104 is rolling off production lines at the greatest rate in its history. F-104s are being produced in 7 nations for 11 air forces, including the United States. Never before have so many nations been brought together to build one weapon for the common defense.

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Twice the load . . . half the seat-mile cost

Sikorsky's twin-engine S-61 means twice the payload of its piston-powered predecessors, the S-55.

Even better, it cuts seat-mile cost by half! (Seat-mile costs have been halved with such new Sikorsky designs from the S-51 through the S-52, S-58, and S-61.)

To date, operating costs for the 28-passenger S-61

have averaged only 8¢ per seat mile. Sikorsky is currently designing advanced helicopters that will reduce this figure even further.

Thus emphasis on engineering progress has always characterized Sikorsky Design. It is a key reason Sikorsky leadership is vertical flight.

Sikorsky Aircraft

DIVISION OF UNITED AIRCRAFT CORPORATION

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Eastern Is Resuming Flights on All Routes

Washington-Los Angeles Air Lines last week was scheduled to resume service to all 119 cities along its main routes along approximately 480 pilots it had trained in flight operations plus about 100 captains who returned to work despite their union's June 23 strike against the company.

On Sept. 13, when Eastern was in its ninth, of 101 summer flying schedule, it planned to offer about 3,800 daily a.m. to mid-out of its Miami home base. Last summer the company's daily figure ran 3,500 to 3,600 seats. It is now operating its fleet of 34 Martin 404s, which are scheduled for retirement; the company still planned to offer service at all scheduled stops by substituting larger Douglas DC-7s and Lockheed Electras for some of the Martins. But frequency of service would be decreased at several trouble cities, according to the company.

In a related development last week the Flight Engineers International Association (FEIA) announced it had agreed to order Eastern to "test and accept" alleged violations of the Railway Labor Act during the strike. In a 34 event complaint FEIA urged the Board to suspend or revoke Eastern's operating authority if it refused to act up a grievance board and take other steps the union said were mandated under the Railway Labor Act.

Federal Aviation Agency, meanwhile, said that FEIA has over 40 photographs taken by its members of airline pilots allegedly sleeping or reading in the cockpit during scheduled flights. Eastern, the union had submitted 39 such photographs in response to an agency request, while stating that other "non-computer" pilots in the process.

Avro 748s Grounded

New Avro 748s were grounded after two in flight accidents following loss of main entry door. In one case, a door was not locked from the plane at 10,000 ft. on Aug. 16, but there were no fatal injuries on the ground.

Manufacturing problems in that door locking mechanism was first possibly up-and-down and points that have been on earlier accidents in other Avro 748 test planes, as is operated by Stevens in Great Britain. Company, however, is considering a modification to pilot gear warning prohibition lights to eliminate any possibility of human error.

Since the two accidents, Avro tested some, along with other personnel, have made a test flight in which the door was deliberately blown free in tests of the lock system.

ion of another engineer could not be obtained. In the interim, FAA was attempting to authenticate the first set of photo graphs. When this was done, it said, disciplinary action would be started against those pilots that could be identified.

CAB Probes Chicago Helicopter Traffic Jolt

Washington-Civil Aeronautics Board last week issued an investigation which could dramatize Chicago helicopter Airway substandard operations.

Because of CHA's heavy traffic density, caused by the late war of the Board and it wants to decide soon whether to issue the carrier's authority, which expires Aug. 6, 1963. The Board said that its action is "contingent with, and subject to, a report by our stated policy of keeping the substandard operations of the helicopter as permanent at a carefully controlled level consistent with the requirements of the public interest."

CAB spokesman said that while the carrier legally has until February, 1963 to file for certificate renewal, the time necessary to study its application accepted then would probably extend well beyond Aug. 6, 1963.

The Board expressed concern over CHA's declining traffic, due primarily to a shift of scheduled airline operations from Midway. Report to CHA Field, and noted that total CHA passenger operations rose from 15,255 during the second quarter of 1961, as compared with 9,868 during the same period of that year. Carrier's decline was noted in CHA's heavy passenger drop from 35,000 to 32,588 during these quarters, periods. Mail tons also dropped at Midway from 56,676 to 14,475 in these comparable quarters, but increased at O'Hare from 576 in 1961 to 15,175 for the second quarter of 1962. "Clearly, however, the decline in passenger traffic may have a significant effect upon CHA's ability to maintain a scheduled service."

Nonetheless, it may also indicate a changing pattern of demand for helicopter service in the Chicago area. The Board's Bureau of Economic Regulation said had recommended

operation of service for all 19 cities. At Midway, American, Standard Aerial, United States, Western Airlines, South Air Transport, Air Cargo, Air Taxi, Airline Transport, Western, West, Airline, Greater City Aerials, Fairmount Airlines and Associated Air Transport.

CAB's proposals are designed to require more financial stability from the supplemental, continuing operations by the carrier and greater insurance protection for passenger injuries in future. Carriers would be required to perform at least 250 annual flight hours per calendar quarter.

Minimum limits on liability insurance would be \$50,000 per passenger for bodily injury or death or a maximum total amount for each accident in an aircraft equal to the product of multiplying \$50,000 in 75% of the number of seats. Non-passenger liability would be set at the same \$50,000 rate per passenger, with \$100,000 as a maximum for each accident accident.

The airlines would also be required to file monthly statements on accounts receivable and payable and quarterly reports on anticipated future profits for each succeeding three-month period, plus revenue aircraft hours flown during the previous quarter.

FAA to Flight-Check AF Navigation Aids

Washington—On June 1, 1963, Federal Aviation Agency will accept initial responsibility for flight-checking the accuracy of Air Force navigation aids in the U. S. and abroad under a joint agreement announced last week.

FAA will flight-check all military navigation aids in the U. S. beginning Jan. 1, 1965. On the following April 1, it will assume responsibility for those in Europe and the Middle East. For Eastern facilities will be flight-checked from June 1 on.

Approximately 1,600 Air Force navigation aids are involved. Flight-checking Army, Navy and civil navigation aids also is done by the agency.

Group Fare Proposal

New York—First World Airlines has suggested CAB approval of new "open pass" group fares between New York or Chicago and the West Coast. Fare would be 25% less than coach.

The "open pass" designation means a person could fly from either New York or Chicago to Los Angeles, then make his return from San Francisco. Available to groups of 15 or more persons, the fare would require a minimum of 10 days and no later than 30 days after departure.

CAB Proposes New Supplemental Routes

Washington—Civil Aeronautics Board proposed a new set of regulations to control supplemental airline operations last week as 18 applications presented their cases for supplemental authority.

The Board's Bureau of Economic Regulation said had recommended

Titanium

vessels of unlimited size for liquid hydrogen

TMCA's cryogenic grades...and

Beech's experience with

7,000 gallon tank open way to

Titanium can hold more liquid hydrogen at less tank weight than any other metal, and still give you impermeability to hydrogen, generous elongations and notch toughness down to minus 423°F.

In brief, titanium then becomes the easiest way ever devised to buy more payload. And titanium can be used to produce tankage of unlimited size. Here's proof:

1. Beech Aircraft has successfully hydrotested a 7,000 gallon welded titanium tank, produced under an Edwards AFB contract.
2. Titanium Metals Corporation of America has introduced titanium alloy compositions modified especially for liquid hydrogen service. You'll have to know as much as possible about them — as fast as possible — to keep ahead of the LH₂ field. TMCA can help you here.

One-third lighter than stainless. The Beech titanium test vessel measures eight feet in diameter by 24 feet in length. Although its weight is classified, it weighs almost one-third less than a theoretical optimum stainless steel alternate.

The stress of the titanium test tank — the largest assembly of its type yet built — makes even larger vessels practical. It was fabricated from sheet supplied by TMCA to less than AISI tolerances, in thicknesses ranging from 0.014 to 0.025 inches. Beech reports that the weight of this titanium test vessel could be reduced by 50%, by using even lighter-gage sheet and designing with titanium's high strength and ductility at liquid hydrogen temperatures.

Titanium grades for liquid hydrogen. Titanium Metals Corporation of America has introduced two grades of titanium modified specifically for service at liquid hydrogen temperatures. They are the "ELI" (Extra-Low Interstitial) grades, Ti-6Al-4V and Ti-5Al-2.5Sn. The Beech tank was produced of Ti-6Al-4V ELI. Both alloys have strength-to-weight

Table I — Typical Tensile Properties of Ti-5Al-2.5Sn ELI

	Test Temperature		
	70°F	-320°F	-423°F
Yield Strength, psi	202,000	169,000	206,000
Tensile Strength, psi	217,000	181,000	229,000
Elongation, %	28.4	18.6	25.9
Reduced Tensile Strength, psi	155,000	200,000	250,000
Reduced Unreduced Tensile	1.38	1.26	1.09

Table II — Typical Tensile Properties of Ti-6Al-4V ELI

	Test Temperature		
	70°F	-320°F	-423°F
Yield Strength, psi	127,000	302,000	268,000
Tensile Strength, psi	139,000	249,000	263,000
Elongation, %	14.0	13.0	7.0
Reduced Tensile Strength, psi	109,000	205,000	233,000
Reduced Unreduced Tensile	1.23	0.94	0.90

ratios at cryogenic temperatures that are superior to stainless steel and aluminum (see Figure 1). At the same time they retain toughness — a fact that few materials can approach. Control of interstitials also enhances the rolling characteristics of the grades in production of wide, thin sheets needed for LH₂ programs. For example, material is now available in such representative sizes as 0.014 x 36 in a coil and 0.020 x 48 x 120 in.

TMCA your best bet in titanium. The best bet today for cryogenic vessels in high-energy modes is titanium. Its successful fabrication in large tankage, such as the Beech test, reinforces the fact that first-gage titanium still is hard. And if your best bet is titanium, then TMCA is your best bet in titanium. TMCA is the nation's only company devoted exclusively to titanium and is the only organization with the experience provided by an extensive history of 344-page technical 66405864.



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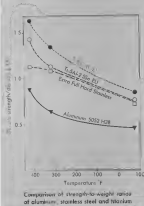


Figure 1. Curves show superiority of new ELI grades of titanium to stainless steel and aluminum, as a strength-to-weight basis. Colored Ti-6Al-4V ELI and Ti-6Al-4V ELI (for extra low interstitials) the new cryogenic titanium grades also retain toughness at low temperatures and impermeability to hydrogen.

Largest titanium assembly ever made, the 7,000 gallon test vessel designed and produced by Beech Aircraft, measures 8 feet in diameter by 24 feet in length.





Hawker P.1127 prepares for takeoff during the Flying Display at Farnborough. Run up of the 13,000-horsepower Bristol Siddeley BS.55 powerplant can be accompanied with the nozzles in the forward position, resulting in a thrust vector problem.

Hawker P.1127 VTOL Strike Fighter Demonstrates

With nozzles in the full down position, the nose wheel leaves the ground. Spray provides an indication of the flow pattern of the deflected thrust. In the background are English Electric Lightning of Royal Air Force No. 74 Squadron.



As the first outlet nozzles of the BS.55 are moved downward, the P.1127 begins its vertical takeoff. Here, the outboard gas on the right wingtip has just lifted from the runway. Spray is due to water on the runway.

Vertical Takeoff at Farnborough Flying Display

Now heading gear beneath the fuselage begins to lift from the ground as the pilot rotates the P.1127 into a near-high attitude. Photos are a sequence of a single takeoff, but were taken from different positions with several cameras.





Full throttle, the F-112 begins its vertical ascent for transition to horizontal flight. Inletside canards or intake lips are in fully extended position. Edge changes while ascent from a sharp edge to a rounded shape to provide more efficient air flow during lowering.



Still in vertical ascent, the pilot begins to retract the outrigger gear on each wingtip of the F-112. Unique inlets on wings and tail as a combination of the workings of Boeing, U.S. and West Germany, all of which have contributed development funds.



Noise ports and intake gear drop into their respective wells as the F-112 prepares for transition from vertical to horizontal flight.



Swinging every solid strand after gun is fully activated, P-1127 pilot begins swiveling the B6-73 nozzle back to the horizontal position for conventional flight and, moments later, a low altitude high-altitude gun over the field.

An inset photograph of the P-1127 shows ground-airlift configuration as well as wing planform and cockpit arrangement.



EXISTING FACILITIES for initial requirements: (1) *Tapco* hydrotest from large nozzle weight; (2) *Mechmet* file the *Revo* for expansion to handle the 120"; (3) *Welding* of 120" and structure done in *Steel* units that handle nuclear reactor core;

(4) *The same assembly techniques* designed for *Starliner* will be used in big nozzle program; (5) *Adhesive* in production; *Tapco's Colwell Materials Research and Engineering* Center acts as materials evaluator, process and quality control

TAPCO "scales up" for big-booster nozzles

Now manufacturing the largest nozzle ever built for solid rocket boosters

Tapco is existing facilities to fabricate nozzles for various programs for big solid boosters in size ranging from 120" to 360". Various nozzles specifically for the 120" stage program will be completed this year with in-house facilities.

Then, a long-time propellant-component subcontractor serves with the rocket industry into its new era of colossal dimensions.

One of the most diversified supplier backgrounds in industry qualifies Tapco to make the transition . . . to mass production of big nozzles confident of meeting every requirement of the process. And that background is this:

Materials Personnel of the Colwell Materials Research and Engineering Center provide the knowledge and control of materials, welding in the design and for quality assurance and reliability

of the end product. This has been demonstrated in many programs including *Minuteman*, *Polaris*, *Avco*, *Perth* and the *Large Solid-Booster* program.

Flexibility Personnel: Understanding of all metal-fabrication methods. From simple and special-product programs. Tapco has acquired diversified experience with hydrotest, submerge, high-pressure welding, and tape and filament welding.

Marketing & Marketing: Large-component experience from production of thrust nozzles (main core) whose dimensions and quality requirements parallel big nozzles.

Manufacturing: Development of honeycomb structures as demonstrated by the 35-foot solid collector for the *Starliner* system.

Equipment: In-house design and fabrication

of speed handling equipment from broad GSE experience with business made in major service-leaders.

Inherent in this diverse activity is the experience of program control . . . planning, scheduling, routing, inspecting, liaison . . . for the efficient and economical delivery of reliable components.

It is this background that enables Tapco to proceed with the production of a full-scale 120" solid-propellant booster nozzle.

It is this experience that enables Tapco to plan in detail the "mass production" of 120", 150" and 240" solid-propellant booster nozzles.

And it is this experience which permits Tapco to suggest that mass production can be reduced to a relatively simple "under one roof" undertaking . . . at unit savings in the large booster programs.



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PARALLELIZATION of large solid-propellant rocket nozzles at Tapco.



"MASS PRODUCTION" in short say about: Two-dimensional detail of large-nozzle production facility. Inset shows vehicle developed by Tapco to route its diverse assembly.





POLARIS—Called "America's mightiest sea defender," Librascope's target data input units, ship's position/latitude/longitude, missile-missile units, guidance-correction input panels, integrated units and reaction units. Like the rest of the Polaris weapon system, these units were delivered ahead of original schedule.



ASROC—The computer which directs firing of the Navy's anti-submarine rocket weapon system, a member of U.S. defense B-6, one of the latest of 11 major Librascope contributions to ASW during 1960-1966. Many of this underwater fire control systems of the Navy's anti-submarine fleet today were designed and/or built by Librascope.



PENTAGON—After 1963, this Librascope multi-processor system, a key sub-component of USAF's A-10, command and control system, will support U.S. global strategy. One of many new, large-scale computing computers with which Librascope serves the growing needs of business management, science and the defense establishment.



CENTAUR—The first computer designed to guide an explosively enhanced package to a soft landing on the moon will be carried aboard NASA's Altair/Centauro spacecraft. One of the smallest and lightest guided pursuit digital computers known. It is typical of many environmentally designed Librascope computers for space vehicles and missiles.



SURROC—Fire control for the Navy's first long-range ASW weapon system is furnished by this Librascope digital computer. It directed the complex target approach pattern of a subsurface-to-subsurface weapon with four modes of operation on every shot: underwater launching, atmospheric boost glide trajectory, water re-entry and target contact.



AIRLIFT—First Librascope aircraft data processing system will participate in global air/sea missions aboard the C-141 transport. It inputs heading reference, air data, TACAN, LORAN, radar control inputs. Outputs: In-flight, right-quarter, compass, altitude, direction, speed, height, ground speed, fuel, engine, heading, heading, heading, heading.



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From tactical weapon control to space research to Pentagon strategy, some of the nation's most advanced military and scientific projects depend on Librascope equipment for data interpretation and the control of weapons and operations. Dependability of performance is steeped in the maturity of Librascope experience that dates from the earliest years of computer technology. Above are examples of electronic and electromechanical

nerve centers produced by Librascope for systems in today's news. □ The needs of commerce and industry, too, are met by a wide variety of computers developed and produced by Librascope for scientific and engineering studies, opera-

tions analysis, product research, industrial process control, and air traffic control. □ Whether your project is industrial, military, or government, consider taking your computer-control, data-processing requirements to the developers of many major operational systems.

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P3V-1 Range Improves Patrol Capability

By Larry Woods

Potomac River, Md.—Fuel capacity of the postwar version of the Lockheed P3V-1 Orion reconnaissance patrol antisubmarine aircraft accepted by the Navy here recently, will enable it to fly 14 to 15-hr. patrols covering more than 32,000 sq. mi. It will be able to carry a greater load of detection gear and weapons than any aircraft ever developed by the Navy.

First element of three P3V-1s was delivered to Patrol Squadron Eight (VP-8) here at the Naval Air Station, Norfolk, Va. at the end of September, the squadron will have its full complement of 12 aircraft, replacing the Lockheed P3V-2 Neptune, the latest of a model series that has seen service in the fleet since 1948.

1 ordered for the P3V in fiscal 1962 was \$108 million for 42 aircraft. For fiscal 1963, this has been increased to \$225.1 million for 48 aircraft.

Range capability of the Orion is so great that the Navy is planning to try to break the world straight line unrefueled flight distance record this fall. The record, 32,109 sq. mi., is now held by an Air Force Boeing B-52. Under straight flight optimum conditions, the Navy hopes that the P3V-1

will be able to fly about 15,000 sq. mi. Before the B-52 record was set, this unrefueled distance record had been held for 17 years by the Lockheed P3V-2 Neptune.

In addition to greatly improved range, speed detection and kill capabilities, Navy officers said the P3V-1 provides a measure of crew comfort that will make the operations more efficient during the long patrols. The fuselage is strong enough to be unheated despite a mass of electrical, electronic and other gear. Crew members do not need to wear pressurized flight suits or crash helmets.

A natural crew of 10, rotating at the operating positions. The turning positions until all aircraft have been delivered, the crew will range from 12 to 14. A large crew rest area at the aft end of the fuselage contains two bunks and a galley equipped to heat frozen food-wrapped meals.

The four-engine functions of the Orion will be controlled from a single panel along the left side of the fuselage over the wing root area. Normally this will be manned by one officer and four enlisted technicians. Highly sensitive radar will be used for long range intercept of suspected submarines. In the event that the sub-

marine continues to evade a homing torpedo would be used for the kill.

If the submarine submerges, a pattern of searchlights would be dropped which would illuminate the ground of the submarine's position to the aircraft. An automatic computer would coordinate these searchlights and give navigation directions to enable the aircraft to approach for a kill.

Searchlights are stored in racks on each side of the fuselage aft of the operating positions. Nine searchlights in one series can be dropped through a retractable door in the floor of the center of the fuselage between the tanks. This would be done in low altitude flight when the cabin is pressurized. An other opening provides for dropping a single searchlight when the cabin is pressurized. This would be used for precision detection while the aircraft was descending from a high cruising altitude.

A launch bay is located under the wing and cockpit section of the aircraft, housing the appearance of a fixed bulge ahead of the wing on the underside of the fuselage. It can carry conventional depth charges and homing torpedoes. There are four pylons on the under-



S-62A Will Transport Thailand Officials, Dignitaries

Sixteen S-62A single-engine, 10-passenger helicopters will be delivered shortly to the Thailand Police Department for use in transporting government leaders and dignitaries. Helicopters in painted orange, gray, red and white. Second S-62A has been ordered by Thailand police for search and rescue operations and troop transport. Both will be delivered at Gulf of Thailand near Bangkok.



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side of each wing, three under the outer wing panel and one between the in-board engine and the fuselage. The subsonic pylons can carry a variety of weapon stores, including Zeus rockets, rocket pods and missiles. Conventional depth charges are no longer carried on pylons. The subsonic pylons cannot carry missiles because the jet-peller area blocks the forward view.

A searchlight hangs under the right wing tip on its own pylon. Electromagnetic countermeasures (ECM) gear is located in each wing tip.

A boom protruding from the tail of the aircraft carries the magnetic anomaly detector (MAD) gear. This is used for low altitude location when the submarine position has been generally determined. It acts as a backup system to the sonobuoys.

In some respects the P3V-1 is an outgrowth of the conventional Lockheed Electra. It is powered by four Allison T56-A-10W turboprops rated at 4,010 hp each dry for takeoff and at 4,160 hp with water-alcohol injection. Profiles are Hawtrey Standard, 13 ft in diameter. The Electra has less powerful Allison J46-D11 engines.

The Navy specified more stringent requirements for the aircraft to enable higher loadings in some areas. It includes stronger wings and other structural modifications. The P3V must be able to withstand 1g in turns and pullouts instead of the Electra's ½g. Engine nacelles are mounted 2 in. higher and the thrust lines of the in-board engines are inclined slightly higher to eliminate shock waves from propellers beating against the fuselage.

Leading edges of the elevator and rudder surfaces are electrically heated for anti-icing purposes. The Electra was hot air bleed from the engines. Leading edges of the wings of both are heated with hot air.

Generally speaking, the loading problem is the same as the Electra, but the same solution, with the exception of the bomb bay. Since the bomb bay is not pressurized, a pressure deck

Spirale 3 Support

East-French government has threatened its support of the Dassault Spirale 3 reconnaissance transport due to lack of credit needed for financial distress in point to the French air force's modernization program.

The Dassault aircraft was selected rather than the P3V as an anti-submarine force for a small transport (AW Feb. 29 p. 41). French air force had estimated 150 million for the project.

The last prototype was scheduled to fly next year.

had to be designed. Nevertheless the vertical web strength structure remained the same in this area, extending through the pressure deck. Most of the Electra's major fuselage loads are being used in production of the P3V.

Gross weight of the P3V is 127,500 lb, versus 116,000 for the Electra.

In order to accommodate, wing fuel, the wing sections over the wheel wells were converted into tanks and the wing section under the fuselage was modified, giving the P3V a "wet" wing from tip to tip.

Tank No. 1 and 2 are in the left wing and No. 3 and 4 in the right wing. The center tank is No. 5, enclosing a bladder cut located forward of the front wing house and aft of the bomb bay. On the right side between these two sections of Tank Five is a 300-gal tank for the water-alcohol mixture.

A hydraulic struts center is located just forward of the rear section of the fuselage under the floor. It is pressurized and accessible in flight. It contains the main screwers and associated plumbing.

The main electrical center is located on the right side of the fuselage opposite the fuel quantity gauges. It is designed with three buses, two of which are in operation at any one time. In the event of failure of one switching a automatic to the standby bus, the change being indicated on the engine's panel.

Power is furnished by three General Electric 60 KVA alternators on engines two, three and four. It is one less than the Electra. Power demands for various fuselage heating of the Electra account for the difference.

The cockpit is about the same as the Electra. The flight engineer's position is between the two pilots. In an emergency, the plane can be operated by the pilots alone. The control system is zero boosted. Cables of the control system are increased substantially.

An Echipe Perennet PB 38 altimeter offers a convenient position when pressure is applied to the altimeter at elevation. It also provides altitude holding from the radar altimeter.

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Rotary Sales

Rotary wing aircraft manufactured sales and deliveries in Bell Helicopter Co. and its Bell and Japanese manufacturing companies totaled 58.6 million, and 111 units in the first six months of 1962 compared with 95 helicopters valued at 56.5 million delivered in the same period last year. The new power Model 2040 (H112) was calculated for the first time in sales reporting. Commercial sales total included both those to end customers and to foreign military forces and included through Mutual Defense Assistance Plan funding.



NAVY AND FEDERAL AVIATION AGENCY test pilots are flying Cornell Aerospace Laboratory's variable stability Douglas B-26 under program funded by the two services. During mid-flight demonstrations, pilots learn to recognize and identify stability and control forces that, in combination, make an aircraft behave in an characteristic fashion. The probe extending from the nose of the aircraft is an angle of attack vane that is used for measuring angle of attack and rate of change.

B-26 Will Simulate Supersonic Transport

By David H. Hoffman

Buffalo, N.Y.—Variable stability aircraft, which Cornell Aerospace Laboratory is using here to teach pilots more about the intricacies of stability forces and control forces, may prove valuable in the development of a safe and easy to fly U.S. supersonic transport.

To date, 103 students at the Navy Test Pilot School have taken short courses on variable stability and control in a Douglas B-26 modified by Cornell. Two Federal Aviation Agency engineering test pilots, whose job it is to certify new aircraft or major modifications, have just completed more elaborate courses of instruction involving eight flight hours in the aircraft.

To study the problems of re-entry, all seven of the X-15 pilots flew a Lockheed T-43 instrumented for variable stability at Cornell.

This fall, Cornell's variable stability B-26 will be flown to National Aeronautics and Space Administration's Ames Research Center in California and used there to gather data on supersonic transport handling qualities. This contract program will attempt to determine whether NASA's ground-based models too accurately can predict how various supersonic transport designs will respond to a pilot during approach and landing.

When the typical pilot manipulates the controls of an aircraft and is not satisfied with its response, he often cannot explain why or even an important factor meaningful. Should this breakdown in communications occur after a airliner at FAA engineering test flight, the consequences could prove to be disastrous.

To dive, the average pilot instinctively pushes the stick forward. He makes a mental note of his plane's performance—rating it good, fair or bad. But rarely does he consciously learn how much force was required to move the stick, X distance, how rapidly the aircraft responded, how much stick control produced this response, whether the nose bobbed or oscillated as it fell through the horizon, or whether his dive angle steepened slightly despite a constant stick pressure.

The value of the variable stability aircraft is that it can train a pilot to evaluate each of these and other factors, all of which usually occur in an instant.

As this Astorian Wharf pilot learned during a 2-hr flight in the B-26 here, it does that by translating single and then in combination the motion of motion described by an aircraft when it is disturbed from straight and level flight. Clifford Bell, the Cornell engi-

neer-pilot in the right seat during the demonstration, made the B-26 behave like a dozen different aircraft. They ranged in type from a Century Series fighter at high altitude to a large transport with its center of gravity displaced beyond tolerance.

The variable stability concept is not new, nor does Cornell have a monopoly on such aircraft. Its B-26, which has variable stability only around the pitch axis, was converted in 1971. NASA has engineered similar aircraft.

But Cornell, now working on its aircraft variable stability conversion, has sold the idea not only as a means of evaluating aircraft handling qualities in flight, but also as a flying classroom to improve a test pilot's grasp of aerodynamic fundamentals.












To convert an aircraft for variable stability, engineers first disconnect the mechanical linkages between the left or right-side controls in the cockpit and the primary control surfaces. Servos are then installed at each end, with one set driving the control surfaces and another the pilot controls.

When the pilot applies a force—to move the elevator, for example—transducers generate an electric signal that causes the attached servos to move a proportional distance. This signal is relayed to a control surface vane, which

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Tomorrow's? For tomorrow SFS is already looking at steel bolts beyond 300,000 psi... is delving deeper into the refractory alloy spectrum and into the fastener implications of cryogenics... is evaluating new heat and thread forms to better combat the violence of fatigue.

What makes for this all-out capability? It starts with design. Not just interpretive design, but original design that attacks the problem of increasingly severe environments in terms of complex fastening systems. And always the goal is to boost the properties of such systems in direct proportion—higher tensile, higher shear, higher fatigue.

Designers' design must in turn be evolved for refractory. No one in the industry has more extensive facilities for this than the SFS Aircraft-Machine Division. Micrological microscope sensitive to 0.00001 in., complete equipment for photomicrographic analysis, production photo-screen, tensile machines with capacities to 400,000 psi, fatigue machines capable of loads to 250,000 lb. and speeds to 25,000 rpm, such as available for two environments to 2000°F... the environment here is enormous.

No less vital is manufacturing capability, starting with material procurement to disassembly that meets SFS' demand to be traced back to its original lot and analysis. Then, too, SFS maintains power in understanding the industry. Cutting, forming, forging, thread rolling, heat treat, cleaning, plating—complete facilities such. Indeed, they asked SFS what this industry can be built into its fastener only by 100% improvement control—to SFS standards. Then the open end of fastening machines are self-directed. And they are refueling the open end, not only in the open end, but in the open end of the open end.

Vital, then, are auxiliary capabilities—tool manufacture, for one. Because SFS specifications usually run higher than industry's Government specifications, much customarily available tooling cannot produce a precision fastener by SFS standards. Here SFS makes all its thread roll dies—for closer tolerance control across the board and because only SFS has created certain special thread forms such as used on its production beryllium bolts.

Then, too, is SFS capability—a complete process fastener capability assumed anywhere. We use it internally.

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Span-Lock® Head Fastener
Class Bolt, Alloy Steel, Shave Alloy Steel, Cadmium Plated, Aluminum, Acornite, Nut
CRS Steel
Servicable to 550°F
100,000 psi min. Tensile
Size: 1/8 through 1/2 in.
Finish or Plating: Head



DN 112 and 1194 (Discard) Series
Self-Locking Nut
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Servicable to 550°F
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Size: 1/8 through 1/2 in.

*Key: 1/16 in. OD, No. 10, 1/8 in.

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SA 16 Series
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Steel, Alloy Steel, Cadmium Plated & Lead, Nut Alloy Steel, Cadmium Plated & Lead
Servicable to 550°F
125,000 psi min. Tensile
Size: 1/8 through 1/2 in.
Self-Locking or Non-Locking



SN and SNB Series
Flanging Squeeze Nut
Alloy Steel, Cadmium Plated
Servicable to 550°F
100,000 psi min. Tensile
Size: 1/8 through 1/2 in.
Self-Locking or Non-Locking



NS 238 Series
Disc Squeeze Nut
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Self-Locking or Non-Locking

Self-Sealing Nuts



SPS 14151 or 14151A Series
Self-Sealing Dome Nut, 3-Lug
Alloy Steel or CRS Steel for use with
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1180 Series Tension Fastener
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Nut Alloy Steel, Cadmium Plated & Lead
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Recessed in 3-Lug, 3-Lug and
Caster Styles, 150 in. Tensile Load,
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Structural Panel Fasteners



1192 Milstar® Series
Bore Bolt and Receptacle Alloy
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Alloy
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Self-Locking and Non-Locking

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also moves a distance proportional to the force exerted by the pilot. The control surface responds accordingly. By adjusting the sensitivity of the servo, an instructor can make the variable stability aircraft duplicate the control "feel" of almost any aircraft he wishes to simulate.

Independent Sources

At this point, the aircraft has variable control but not variable stability. To give it this quality, inputs from other, independent sources are directed to the control surface servos but not to the cockpit control system. Typical of such inputs—those inputs after the aircraft's behavior—its angle of attack, rate of change in angle of attack, roll slip angle, and rate of roll or yaw.

Of course, inputs to a pilot is the short period motion of an aircraft around its pitch axis. With a life of 1 sec. or less, this inherently rapid oscillation, expressed in cycles per second, represents transient response of the aircraft to control inputs.

Natural frequency of the short period motion is very responsive, fighter-type aircraft is high, in larger transports it is lower.

In most variable stability aircraft, both the duration of the short period motion and the damping that follows it can be changed almost instantaneously.

Cornell's B-28, an aircraft designed for one pilot, must be tested by the student, because the instructor in the right seat has no brakes. On a close review last month, we signed the aircraft for testing at Bell's municipal airport. Bell took over when he got radio control and we climbed to 3,000 ft., paralleling the south shore of Lake Ontario where there was little likelihood of conflicting traffic.

Clutch Mechanism

With the B-28 set up to simulate a B-26, we engaged its variable stability system by throwing a clutch mechanism on the floor at our feet. From that point on, we were flying B-26. But so smooth was servo operation in the system that this fact, somewhat distracting at first, was soon forgotten. No trace of the artificial feel Bell introduced, there was apparent in the B-26 controls.

One touch moved our axis across. But cables linked Bell's control column directly to the plane's elevator and as a result, his valve punched and jolted throughout the demonstration, opposing whatever the elevator did to vary longitudinal stability of the B-26.

Normal damping rate of the B-26 is about 0.7, the natural frequency of its short period motion is about 0.45 cps and standard twist forces, expressed in pounds per g, are about 40. That was

DEFENSE CONTRACT AWARDS

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our reference framework. The first variable introduced by Ball was to reduce damping first to 0.4 and then to 0.2. Selecting a burn at about 2.5 G's and roughly 30 days before the launch, we tested the B-36 over and attempted to acquire it from a horn. In the abrupt tracking maneuver, which might provide loads of an aircraft wings at high altitude, the B-36's were hobbled in detecting and assessing loads. At the 0.2 damping ratio, it oscillated through the point instead of just fine-tuning before settling down.

Our attempts to compensate for the bubble made the aircraft even more damped and exaggerated what we were trying to correct.

With zero damping, tracking was next to impossible, and instrument flight, had it been attempted in such an aircraft, would have required a pilot's total attention.

Next, Ball changed the natural frequency of the B-36's short period from 85 cps to 0.6 and cut required stick forces to about one half. In this configuration, the aircraft behaved as if it had lost 10,000 lb. Response to control pressures was so sudden and the controls so sensitive it was evident that an aircraft with similar handling qualities could be damaged inadvertently during relatively routine maneuvers performed by its pilot.

Even the most bank configuration can be demonstrated to the variable stability aircraft without endangering its crew. For the system can be disconnected instantaneously by depressing a button on the control yoke, either the shocker or the instructor can depress the sensor of all power and motion capabilities should a maneuver prove hazardous. Although it hasn't yet, that could happen when the B-36 is used to demonstrate effect of control action of gusts or the failure of stability augmentation equipment.

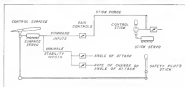
After reducing the B-36's angular in flight permeability, we began simulating various transport configurations. At a natural frequency of 0.1 cps—a short period duration of about 1 sec—aircraft response typified that of the larger piston-driven transports.

But Ball explained earlier, we were not flying cruise. Because the aircraft responds slowly, the pilot can begin a correction during one run of the pond and wait its result on the next. The aircraft's response to sudden gusts would be unnoticeable, even saving passengers uncomfortable G loads. Even while taking violent corner action the pilot would not have the risk of suffering structural damage on such an upsurge.

If, on the past, high stick forces are applied to the low natural frequency, the aircraft becomes less manageable. According to Ball, veteran fighter pilots almost always grow skeptical when told



RHSTOAT GAIN CONTROLS on panel forward of the right control column are used to vary the B-36's stability, stick forces and responsiveness.



BALEMAN SHOWS how student pilot and instructor pilot control and maintain safety of the Const B-36 variable stability aircraft.

the smaller two hundred of transport that possess similar handling qualities. Yet Ball maintains that the B-36 with a natural frequency of 0.1 cps and stick forces of about 150 lb. g's is not like a Douglas DC-4 with its corner of gusts at a little less than 100 lb. In such a powerless aircraft, the pilot, nearly in total control, begins to fly much higher, as true, until the true about actually because the present flight control is better.

When it appears the U.S. super transport probably will have a very low natural frequency, especially at subsonic airspeeds. This too means that its pilot, on landing, must begin his first corner then is customer, perhaps while not yet over the runway's threshold. Whether a professional pilot can cope with that requirement is the variable stability aircraft can, help answer.

As we experimented with the B-36, it became obvious that high stick forces

and low natural frequency can be combined by the same pilot. Both contribute to an aircraft's apparent sluggishness. Variable stability having probable would help in FAA certification test pilot response which is the output is, for example, a light plane that had been modified in its own.

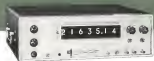
Review of current FAA certification criteria also could result from wide-spread training of engineering test pilots in variable stability aircraft. One such criterion, which many pilots consider unrealistic, is that all aircraft must possess natural stability.

Yet the B-36, when rendered statically unstable, is far more pleasant to fly than when it is made to act like one of the larger transports. Although it will not hold firm, nosecovering and banking are easy, and when the nose is placed on a point, it stays there.

Another question a pilot surely considers is why controls in the cockpit



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most made to move it. As the Piper Cub flies at altitude, stick and rudder pedals move cables that position the control surfaces. Hence stick and pedals must be sturdy. But a rudder lighter, such as the McDowell P-11, pilot pedals activate only electromechanical sensors, which move the control surfaces. Bungee cords create a necessary "soft" for the pilot.

Such a system lessens an aircraft's weight, unproductive weight. In addition, room to move must be allowed the pilot, thereby wasting space in the cockpit.

At the end of our flight, Ball demonstrated the one with which a pilot can maneuver an aircraft equipped with an removable control column. Before linked to the B-26's cockpit controls were adapted to eliminate all travel but pilot pedals still generated a signal which evoked the sensors coupled to the B-26 primary control surfaces.

We found that even with no practice, precise push control was available with the aircraft in this configuration. In trying to acquire a target before the horizon, however, we lowered the nose of the aircraft abruptly—much more so than we would have if the stick were free.

Variable stability training aircraft pilots by Cessna has proved so popular the laboratory is conducting a second B-26, this one with variable stability around all three axes. One of the two aircraft probably will be assigned such duty graduated from the Navy Test Pilot School at Pensacola, Fla., where, since 1963, each class has received a flight instructor in variable stability and control from Cessna.

FAA engineers test pilots predict similar training will be of major value when they pass pilotesque on aircraft handling qualities not dealt with specifically by Civil Air Regulations. Air craft combined under Part 3 of the FAR, for example, must be trimmable and controllable with one hand. Large radial stability must be "positive."

When detached from level flight, suspension can vary as much as 10%.

Between their circuits, FAA controllers point out, there are gray areas in which the check pilot must be subjective. "When we find an aircraft that doesn't quite comply are FAA pilot test Aviators Wertz here, we may be able to pinpoint why and talk knowledgeably to its manufacturer."

Although such advice is not binding on FAA—the agency does not guarantee it will continue in operation after rule flow is completed—its guidelines will aid cockpit operators and managers who apply for supplemental type certificates. These must be obtained from FAA whenever a new modification alters the structural integrity, performance or handling qualities of an aircraft.

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NASA, AT&T Reach 'Conflict' Agreement

By Katherine Johnson

Washington—American Telephone & Telegraph Co. is expected to continue as an active competitor for National Aeronautics and Space Administration business, despite the role of its aerospace subsidiary, Bellcom, Inc., in advice to NASA on various requirements for the Apollo manned lunar landing program.

A statement of understanding, an acknowledgment between AT&T and NASA gives the company a completely free hand to compete for NASA communications business—including communications for the Apollo program. AT&T will be subject to approval by the NASA administrator or deputy administrator. These three positions—Communications, Guidance and Guidance—are the only areas of AT&T system.

The statement, expressed in a letter from James E. Webb, NASA administrator, and countersigned by E. J. McNichols, AT&T president, is "entirely acceptable," was made public by John A. Hornbeck, president of Bellcom, in testimony to the House military operations subcommittee. With Hornbeck's testimony, the three areas—Communications, Guidance and Guidance, headed by Rep. Carl Albert (D-Calif.), concluded two months of hearings on civilian and space research and development management. A report will be issued next year.

Industry has been apprehensive that Bellcom's basic role and close relationship with NASA in the \$300-million Apollo program would give AT&T a competitive advantage for other NASA business.

Hornbeck told the subcommittee that AT&T, as well as NASA, should stay "out of business" in the beginning. He said it was "misleading" by the statement of understanding.

Hornbeck made these observations during Hornbeck's testimony: "What is effect has occurred... that there is a point statement that view shall be no conflict-of-interest involved, and then... there is a complete exclusion of any conflict-of-interest and, as a matter of fact, that is a tragic situation."

"I am not being critical, because, knowing full well the emergency position of the group that is involved here, and their excellent technical ability, I do not know where NASA would go to get better service or even possibly in efficient service, because of your great comprehension of this technology."

"As a recognition of their industrial position in the field of communications and to insure efficient tracking and guidance," the government needs their product. And the government has made a concession which has not been made in other cases—such as Road Corp., Mery Corp., Lincoln Laboratories."

There are three points made in Webb's letter—and contained in the AT&T.

• **Communications.** In this field, Webb said, "it is apparent that the arrangements between NASA and Bellcom should not affect the dual use of the Bell System companies with NASA. Such companies would remain free to deal with NASA in the furnishing of communications services generally, and in connection with the communications aspects of projects such as Mercury, Gemini, and Apollo, on the same basis as if the new arrangements had not been made. There is no reason, other, why the dealings of the Bell System companies with NASA in the communications service field should be affected."

• **Tracking and guidance.** In this area, Webb stated, "there is no restriction on the part of NASA that curbing NASA projects for which the Bell System has been selected to perform work, would be disturbed."

Webb continued:

"We also recognize that the space program may require an future projects... the tracking and guidance capabilities of the Bell System. However, where capabilities in these fields are also possessed by companies outside the Bell System, we would seek to evaluate such capabilities in partnership with the Bell System to determine if participating in a particular future project would not conflict with the principles regarding the existence of a competitive advantage being gained by virtue of information acquired in performing the Bell system contract."

Webb said that he and the deputy administrator of NASA would make a general review before a decision is made to select the Bell System over competitors.

Herbert Reiback, the subcommittee counsel, said "the effect... there is no contract between AT&T and the Bellcom contract relationship. If and when on some new project there is a fact that Bellcom may be given to a considerable amount of special information which could be a competitive advantage, then the administrator will on a case-by-case basis decide whether or not it is appropriate."

• **Other manned space flight contracts.** Noting that AT&T has said it would not seek NASA business outside the communications tracking and guidance areas, Webb stated:

"Similarly, it would be NASA's intention not to call on the Bell System to perform work in these other areas except where, in the opinion of the administrator, it offers a definite advantage in comparison to the general rule should be made. Such exceptions would be rare and would arise only where the Bell System was in a unique position to perform a valuable service for NASA."

An exception to these three provisions on conflict-of-interest, Webb made these comments in his letter to AT&T:

"It is clear that the maximum benefit will be derived from these new arrangements [with Bellcom], only if there is the closest cooperation and understanding between NASA personnel and the Bell System technical group. In addition, a close relationship must exist between personnel involved in performing major NASA contracts and those performing space flight programs and the support group."

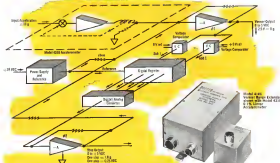
Webb then stated the conflict-of-interest problem involved in the three-way close relationship as "a matter, not appropriate for resolution in the Bellcom contract, which I know we both recognize as an important question to resolve quite explicitly at the outset."

"It is not at all our desire to delay in the space program the major assistance of the Bell System. Such a course of action would be contrary to the national interest. On the other hand, a necessary result of the close relationship between Bellcom and NASA is that the new company will become privy to the lead of information regarding current and future plans and programs of NASA that could give the company a competitive advantage in connection with other work."

Webb then made his three points on conflict-of-interest.

Hornbeck gave the subcommittee three examples of such Bellcom will perform for NASA under its continuing \$15 million system contract. They were:

• Prepare an overall system specification for the manned space flight program. The first step—following studies—will be a short document defining and describing the mission under for Apollo. The studies will be directed at defining the data to be used for the understanding, delineating the interfaces between the subcommittee, and formulating the no-



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Australian Air Force to Use Bell HU-1B in Rescue Role

Royal Australian Air Force will take delivery this month of the first of eight Bell HU-1B helicopters scheduled for service with RAAF's Search and Rescue Squadron 9 based at Woomera, New South Wales. Major difference between RAAF and U.S. Army HU-1B version is an external hoist on the Australian vehicle which can lift up to 600 lb. and be controlled by the pilot in a cabin attendant.

quarters to be met by subordinates.

The second step will be a more complete application for development and operations through the first annual linear briefing. The document will describe major subelements and specify requirements to be met by subordinates.

• Study check-out and branch from the main surface. The objectives are to attach to the critical problems involved in linear branch and the difference between linear and combi branch, and consider various generic and back-up branch and check-out procedures.

• Develop a mission assurance program for Apollo. This will consist of identifying areas of work relating to mission assurance and developing an implementation for each area.

Participation by AT&T as a status requirements adviser to NASA in the Apollo program was launched by Webb in a Feb. 21 letter to P. T. Kappell, chairman of AT&T's Webb unit.

"It would be a public service of the very first order of importance if the Bell System could undertake to assist NASA

by providing its organization of experienced men capable of giving the sophisticated NASA officials the benefit of the most advanced analytical procedures and the factual basis they need to make the wide range of system engineering decisions required for the successful execution of the national space flight program."

A week later, AT&T accepted Webb's proposal.

GE Regroups Defense Electronics

General Electric has formed a new Command System Division from some of the departments which formerly made up its Defense Electronics Division and has established a new corporate-level component, Advanced Technology Services.

Dr. George L. Haller, vice president and former general manager of the Defense Electronics Division, will head the new Advanced Technology Services and become a member of GE's executive office.

The Command System Division, headed by Richard L. Shetterly, includes the Defense Systems Department, which Shetterly formerly directed, the Lunar Mission Support Program (Apollo), Communications Products Dept., Military Communications Dept., Technical Products Dept. and the Electronic Laboratories.

The Defense Electronics Division, which now consists of the Heavy Military Electronics Dept., Light Military Electronics Dept. and Ordnance Dept., will be headed by Gerald A. Hoag, who was formerly general manager of the Light Military Electronics Dept., and prior to that headed the Ordnance Dept.

During the last several years, the Defense Electronics Division has made good economic growth both as a result of national expansion and through the

transfer of additional departments, such as Communications Products, until its size exceeded that which the firm believes is suitable for its special status under a single general manager. Recently, GE took on its former Missile and Space Vehicle Dept. out of the Defense Electronics Division to give it full divisional status (AW July 9, p. 26).

The new Advanced Technology Services has been formed, GE says, "to strengthen the bridge between industrial research and a sustainable end product." The company's General Engineering Laboratory in Schenectady, N. Y., has been transferred to the new organization.

The General Engineering Laboratory, originally established to serve as a general development facility for the cable company, has grown to be a problem in recent years. During the early post-war period it became heavily engaged in defense and government sponsored work, with the result that many departments in the company set up or strengthened their own in-house development capabilities.

More than 10 years ago the General Engineering Laboratory was ordered to sharply curtail its defense work and to return to its original role, but individual departments were slow to resume the private relationship since they now had their own in-house development capability.



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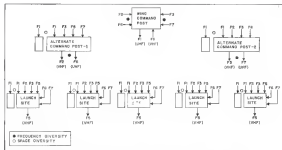
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TITAN 2 RADIO NETWORK uses automatic fault detection, diversity switch to frequency and space diversity to provide reliable command system any default occurs. Arrows show channels used for transmission and reception between outside sites.

Flexible Radio Net to Link Titan 2 Sites

By Philip J. Kass

Two elements of a flexible, hardened radio network designed to provide reliable communications to 16 Titan 2 CBM launch sites at each of three Air Force missile bases have been delivered to General Electric Corporation Products Department, Lynchburg, Va. The equipment is to be installed at Davis-Monthan AFB near Tucson, Ariz.; McClellan AFB near Wichita, Kan.; and Little Rock AFB, Ark.

Variety of techniques have been used to assure reliable communications between the widely dispersed facilities under both pre-attack and post-attack conditions.

These include:

- Standby units are provided for each element of the system, with automatic fault detection to switch the standby unit source in the event of a malfunction.
- Hardened antennas, buried in an 8-ft-deep pit, which can be quickly erected by a gas-lifted piston (crush armor). Two such antennas are provided at each site, either of which can provide the required communication service. During peacetime, both hard and soft antennas are retracted, except for periodic exercising, and conventional self-supporting tower antennas are used.
- Frequency and space diversity are used to reduce the risk of jamming and to

assure an alternate propagation path. The frequency diversity technique involves the use of a VHF channel (115.6-164 mc) and a UHF channel (224.275 mc). The space diversity technique, used only in adverse locations, employs two physically separated antennas, each with its own antenna.

Protected valleys, which make good locations for screening missile sites against blast effects on land, become the standpoint of radio signal

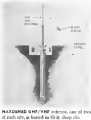
propagation at VHF and UHF line-of-sight frequencies. The situation is aggravated by the alignment between launch sites, which can be as much as 80 mi.

General Electric conducted path-loss analyses of all site-wire topographies and space diversity where necessary, following which it made no site assumptions for the more adverse environment. Out of three studies came the present network configuration, which uses a space diversity where necessary and in the case of Davis-Monthan AFB, special repeater stations at two of the missile launch sites.

The wire command post at each site has a relatively soft vulnerability and its position, hence, is predictable. But both of the two autonomous antennas at each base have a hardened underground command post, located near a launch site. Each is designated as an alternate command post and is capable of controlling the launch of all 16 missiles if necessary. One of the two is designated as alternate command post No. 1 and would take over control of the two antennas if the wire command post were destroyed or otherwise disabled.

The Titan 2 radio network provides three types of communication functions. They are:

- **Primary Alert System.** Command signal received on wire hardened land cables at the wire command post and



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alternate command post No. 1 can be re-transmitted by voice channel to the other alternate command post and to all launch sites. The wing command post broadcasts on a UHF frequency (F1) while alternate command post No. 1 transmits on both VHF and UHF (F2 and F3). Each launch site and the other alternate command post have reconvert tuned to each of the three frequencies (F1, F2 and F3) and standby receiver for each channel. Launch sites at airborne propagation locations will have a second set of antennas and receiver to provide space diversity for reception of the wing command post alert.

• SAC Control System: Codes from signals from the Strategic Air Command Control System (SACS) are transmitted by land cable to the wing command post and two alternate command posts and routinely retransmitted to all launch sites. The wing command post transmits on the same UHF frequency (F1). Alternate command post No. 1 transmits on its own VHF and UHF channels (F2 and F3), while alternate command post No. 2 transmits also at VHF and UHF at frequencies F4 and F5.

Since all sites have receivers for all of these channels, the command signal can be expected to get through at least in one of them.

• Launch Flexible System: The signal which enables the outlets for launch also is transmitted by the wing command post and by both alternate command posts using the same channels.

• Hard Voice: All launch sites have the capability of conducting voice communications with one or all other sites and command posts in the complex on a party line basis. This capability is added to an "hard voice" to distinguish it from the soft telephone line which are installed for general administrative traffic during peacetime. The launch sites transmit on VHF frequency F6, while the command posts transmit on the previously cited frequencies.

These four functions, plus an "alarm tone" which is transmitted continuously to check on circuit continuity and to achieve automatic switching of available equipment, are transmitted on a single channel bandwidth of approximately 42 kc., using a combination of frequency modulation and frequency shift keying. The SAC Control System data (for accompanying chart) is transmitted at a rate of 800 bits/sec. by frequency shift keying (FSK) at the carrier by 410 cycles/sec. The primary alert system (PAS) hard voice (HV), launch cable system (LCS) signal and the alarm tones are analyzed and applied to a phone modulation according to the Martin, CSE paper manager for the Titan command and control system.

Priority alert system voice signal is transmitted in the lower subband of a



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MAREE STATION, left, will be located at Rio de Janeiro. At right, support tower and antenna mount are attached for shipment.

Relay, Telstar Ground Stations Displayed

Two ground stations which will be used with Project Relay communications satellites to conduct telephone and radio-type service experiments between U.S. and South America and between South America and Europe, were shown recently by International Telephone and Telegraph Corp.

The Project Relay communications satellites, being built by Radio Corp. of America under National Aeronautics and Space Administration contract, is scheduled for launch late this year.

One of the two terminals will be located at Niteroi, N. J., site of the ITT Federal Laboratories, which designed and built the station. The other terminal, a mobile station housed in two truck vans, will be installed near Rio de Janeiro, Brazil, and operated by Companhia Radio Internacional do Brasil (Rádiorio), an ITT affiliate.

Bell Telephone Laboratories also recently demonstrated a ground support communications satellite terminal capable of providing a single two-way voice channel, using Telstar. The station used an 870 watt transmitter and a radio shaft 1.6-ft dia. antenna, but 10-ft. size with a 10-ft. dish specially designed for the purpose could provide equivalent performance. The system used two low-noise parametric amplifiers operating in tandem, one cooled to 70°K.

The ITT station for Brazil will employ a 10-ft. dia. antenna, while the Niteroi station will have a 10-ft. dish. The terminals are designed to handle 12 simultaneous two-way telephone conversations, 144 teleprinter circuits or combinations of voice and data. Each voice channel can handle 12 two-way data circuits.

Project Relay will operate at a different frequency than the Bell System Telstar satellites, although both stations at the same frequency of 4,170 mc. Messages sent via Telstar are transmitted up at 4,190 mc. while those to Rádiorio will go up at 4,175 mc.

Each of the ITT terminals is equipped with a transmitter rated 10

kw output and with a receiver that uses low noise (2.5 db) parametric amplifiers. The Niteroi station has a second receiver to monitor its own transmission as relayed by the satellite while the other is used for the receiving signal from remote stations.

The antennas are designed to guide automatic satellite acquisition/locking and for signal reception. The stations also contain telemetry receivers to receive satellite internal conditions.

The Bell System terminal at Niteroi and the French and British stations were

participating in the Telstar experiments are being outfitted with transmitters operating at 4,275 mc. to enable them also to engage in the Relay tests. This should permit signals to be relayed when the satellite position is within transmission range of U.S., Brazil and Europe.

The bulk of the cost of building the two stations has been funded by ITT. NASA provided funds to adapt the Niteroi terminal so that it can also serve as the system control station for the Relay satellites.



RELAY SATALITE ground station equipment is displayed by ITT Federal Laboratories.

NEW AVIONIC PRODUCTS



• **Angle measuring instrument, Model 210**, designed for ground support equipment, servo and control system applications, provides accuracy of ± 0.6 sec., repeatability of ± 16 sec., consistency of 16 sec. and resolution of 56 sec. Instrument can operate, indicate angle in position of an antenna or antenna shaft, indicate and measure rates, transducers, record system outputs, making comparison and action. Manufacturer: Moore Motors, Inc., 11 Van Hook St., Paterson, N. J.



• **Phase shifting transducer, Senc V-55**, which can continuously shift up to phase angle through 360 deg. without reaction, has many applications in radar ranging, frequency modulation, rotary position indicators and phase meter calibrations. Unit contains five triode phase shifters with phase splitting networks and transmission circuits for matching and amplifying phase shifted signals. Manufacturer: Niles Mfg. Co., Box 127, Kansas City, Mo.



• **New Plus Circuit Compensation**—Comparison of three types of identical circuits followed by different compensation techniques will be conducted by the Naval Electronics Laboratory, San Diego. As part of the evaluation the laboratory will obtain different versions of the circuits made by Radio Corp. of America (packaged in its standard unit), Leti Strip (then the micro-

circuit) and Fairchild Semiconductor (microconductance devices). In addition, NEEL will build an in-house welded electronic model, version of the circuit.

• **Improved Gyr Accuracy a Possibility**—New gas-bearing gyros developed by Sperry Gyroscope, an outgrowth of its extensive aerial navigation system (SINS) effort, has draft sites in low that precise measurement is especially valuable in navigation systems. Navy Special Projects Office has flexible plans to compare contract to develop new gyro construction for increasing draft sites.

• **Space Component Group Formed**—USAF's Space Systems Division is heading up new Space Parts Working Group, with representation from about 40 major space program contractors. The group will draw up specifications for electronic components suitable for use in avionics systems, intended to be used aboard space vehicles.

• **New Semiconductor Microcircuit Family**—Watch for Motorola's Semiconductor Division to announce its entry into the semiconductor microcircuit field within the next several months, based on use of planar optical techniques.



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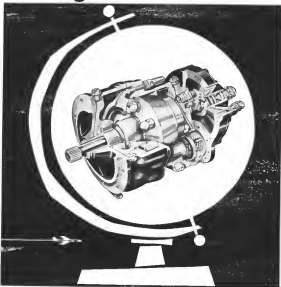
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FUEL AND COMBUSTION SYSTEMS FOR GAS TURBINE AND RAM JET ENGINES

FINANCIAL Unexpected Portland Copper Cost Retards Bliss' Six-Month Earnings

By Arnold Sherman

New York—E. W. Bliss Co.'s results into improved aerospace business through acquisition of Portland Copper and Tank Works last December (ENR 25, p. 162) has not yet unfolded and costs may.

Portland, according to Bliss President Carl E. Anderson, had accepted several foreign contracts from the government which resulted in substantial losses. "Costs to complete these contracts were estimated as of Dec. 31, 1961, on the basis of information available in mid-February, 1962, and where losses were apparent, provision was included in the 1961 accounting results," he said.

Subsequently, actual costs proved the estimates inadequate and additional provisions were necessary. These unplanned windfalls were reflected in the operating statement for the first six months of 1962, and they affected adversely the value of the business as it

was appraised and warranted to be on Dec. 31, 1961, the closing date of the acquisition," Anderson noted.

In the second quarter of 1961 Bliss' net sales were \$23,201,867. Its sales, selling and administrative expenses were \$21,572,574, and net income was \$694,693.

These figures were reflected in common share earnings of 24 cents for that period. In the same 1961 quarter, however, with sales rising to \$29.2 million, costs soared to nearly \$28 million, net income consequently dropped to \$537,918.

Common share earnings declined to 19 cents for the same period.

Anderson, speaking before the New York Society of Security Analysts, stressed that the excessive costs related to honoring the government contracts were not apparent at the time of acquisition due to Portland's accounting methods.

"The Portland Copper and Tank Works, as a private company, and a



Egypt to Produce German-Designed Trainer

German technical concepts are embodied in the jet trainer designed by Altkas, which will be produced by Egypt's first jet aircraft factory. Egyptian President Gamal Abdel Nasser (left, looking into cockpit) inspects the aircraft, with its designer, Werner Altkas, on the right, at the new factory at Helwan. The trainer is the Spanish Hispania HA-300 series, designed by W. Altkas. The Spanish HA-300 is powered by two Turbo-Union Turbo 24 turbojets producing 10,000 lb. thrust each. Egyptian and German will be built in the Egyptian plant. German concepts also were used for designing the Egyptian HA-300-400 as single-engine turboprop (ENR July 16, p. 26), while Dr. Egon Singer of West Germany is a leading hand. Turbo-Union who worked out the turbo-prop concept were largely from West Germany, but others were from East Germany, Hungary and other East European nations.

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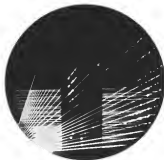
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ZERO LEAKAGE



Close-up view of MARMAN CONOSEAL joint on aircraft engine for extreme temperature/pressure metal gasket shown in test.

MARMAN CONOSEAL All-Metal Piping and Tube Joints for Aircraft, Missiles and Ground Support Equipment

Pressure capabilities up to 100,000 psi, temperatures from -425° to +2000° F with zero leakage.

CONOSEAL Fittings for high performance joints in tubing from 1/4" through 1" are available in stainless steel or titanium. In stainless steel they provide a leakproof seal with working pressures of 4000 psi and burst pressures of 55,000 psi at room temperature. Temperature range from -425° to +2000° F. Compact and lightweight, CONOSEAL fittings can join dissimilar metals, require no post-weld heat treatment. Special fittings available for pressures up to 100,000 psi.

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CONOSEAL Pipe Joints are capable of withstanding high pressures to 20,000 psi and temperature extremes -425° F to +900° F without leakage. These joints provide unusual strength and dependability in such applications as engine ground handling and turbine power equipment. They are lightweight and compact compared to bolted flanges.

WHY MARMAN CONOSEAL JOINTS ARE LEAKPROOF



1. The CONOSEAL joint consists of a male and female flange flange gasket. The gasket is made of a special alloy and is designed to provide a leakproof seal.



2. Flange gasket compresses in the V-shaped recessing surface during tightening. The gasket is made of a special alloy and is designed to provide a leakproof seal.



3. Compressing gasket seals leakage of V-shaped recessing surface during tightening. The gasket is made of a special alloy and is designed to provide a leakproof seal.



CONOSEAL Fitting



CONOSEAL Tube Joint



CONOSEAL Pipe Joint

after the single type of accounting which the missile companies were computed on an estimated basis that would include budget profit and losses," Anderson said. "Records to determine actual results in operation were not prepared at the end of each accounting period and detailed cost records of individual contracts were not available on a current basis."

At the time of the Portland acquisition, terms of purchase included \$5,000 share of Blue preferred stock and 49,000 common shares.

Additional Safeguard

As an additional safeguard, according to Anderson, an indemnification clause was written into the Portland/Blue agreement whereby the original status of Portland agreed to make restrictions on Blue use the status of cost or stock situations occurred "that have not contrary to the representations and warranties."

Anderson said that documents are currently in progress to ascertain the amount of indemnification.

One of Portland's major attractions for Blue was its position as a defense hardware manufacturer. Blue, presently a producer of heavy machinery and originated its interest in acquisition of small companies with diversified interests. It was producing tanks, pots, turbines, compressors and lighter aircraft equipment. Under Anderson's leadership, the company decided upon the Portland/Cogent acquisition to give the company a better competitive position in terms of increasing defense and space activity.

Portland Projects

- Among the projects at Portland are:
 - Thrust vector control nozzles for the first-stage engine of Minuteman.
 - Launching platform for the Hawk missile.
 - Workcells for the Tartar, Talisman and Sparrow missiles.
 - Pulse propellant engine and loading mechanism.
 - Nike Zeus radar antenna reflector.
 - Afterburners for the J55 engine which will be the powerplant for the B-70.

In addition and in cooperation with a facility held in joint partnership with Aeris Associates, Portland is engaged in forming optical and astronomical metal pressure vessels at cryogenic temperatures.

Anderson pointed out that Portland's backlog of orders had climbed from a little over \$9 million as of June 30, 1961, to nearly \$11 million a year later. He said that Portland will account for 13% of Blue's 1962 overall sales. Net sales for Blue in 1961 were \$307,946,714.

Despite the costs of the government contracts with Portland, research and

development for Blue show a healthy increase over the year before. For the nine months ending June 30, 1961, Blue's net sales amounted to \$46.5 million, costs were \$41.1 million, income was \$5.4 million. In the same period in 1960, sales were \$38 million, costs were \$34.4 million, and income was \$3.6 million.

Anderson said that Blue's Launch and Recovery Equipment Division is performing work on a ground test guidance system in addition to its aircraft test activities (AW Feb. 9, p. 99). He also noted that the company, in concluding an agreement with the government to build Blue's missile test facility, the C-100, plans to move from the government for \$1.1 million.

Manned Space Center To Double Employment

Anticipated employment at National Aeronautics and Space Administration's 1,820-acre Manned Spacecraft Center under construction 27 mi. from downtown Houston, Tex., will be 3,768 by the end of fiscal 1965.

This will approximately double the current employment.

Of the total anticipated NASA employees to be hired at MSC, 1,894 will have initial salaries of \$4,515 and 680 will receive \$4,500-\$9,915 and 736 of the employees will receive \$6,916 and over.

Opportunities at General Atomic for Engineers and Scientists

General Atomic Division of General Dynamics has immediate openings for engineers and scientists, including positions in an advanced program to develop a new propulsion mechanism for large space vehicles. This dynamic program involves the use of controlled nuclear pulses to propel large vehicles such as a space platform of 3000 tons or more.

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Although these programs involve work in many new areas of science and engineering, present openings can best be filled by men having experience in the following areas:

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United States of time-proved Jarry pumps, valves, landing gear, flight-control systems, autopilot and stabilizer assemblies. □ Most importantly, the new Aerospace Division offers a single responsibility, single source for complete electro-hydraulic systems composed of reliable, compatible components that are both engineered and fabricated to work together under the stringent demands of a single quality control. □ A combined field engineering staff has been organized to serve customers in the United States, Canada and Europe. □ This dynamic group is prepared to work with you on your programs today. □ Address: 3151 West Fifth Street, Oxnard, California.

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- Fig. 1.** *See text.*

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the pump, the money remaining was not big enough to get the work back done to keep the saloon open from that year. His only choice, so he stated, was to try to get a permit stopped on the runway. But, when called by his family, he, too, went to prison. He was there, however, for a short time. The Sheriff looked kindly, noted a unusual and uniform response from the civilian elements. The 1936 group was leading normally from 1 (2 to 3) and then pulled the "Criminals Fall Back" Capt. C. J. Smith, who was in the room, shouted back into every corner threat and used small bullets. The extended the spread and shot at doors on the pump but without contacting any last hit. He believed that the second group was out of the way. Whether it did or not will be a matter of time. The group would have been taken into those second arrests, as shown in later text.

The instant contained about the full length of the 10,000-ft runway burned it, through a blast hole, cutting on fire, through the airport boundary fence, and across Meadows Boulevard where it struck an automobile, injuring the driver and one occupant. After going through the Meadows, many cars were dented before the aircraft came to rest in flames 550 ft beyond the end of the runway. Emergency vehicles from the airport and of the New York Fire Department were quickly started for the scene. Although impeded somewhat by weather conditions, fire, search and rescue

about six meters and comprehended the first Eucalyptus and most of the acacias had already been collected in a total time of about five minutes, although most persons were not of the woodage and away from the forest in half this time. Most of the surviving were taken by hand, as indicated in the

Witness

During the period from 1990 to 2100 there was a precipitation deficit of 180 ft or less due to snow. Forecast variability remained at less than one mile and gradually dropped to near-zero miles in time and lag. Runoff varied more decreased until it was reported as less than 2,000 ft at the time of the forecast.

The snow consisted of small dry flakes and was blown and drifted by surface winds which averaged 15 to 22 ft/s with gusts up to 27 ft/s.

First quarter (all industry)—broadly close with some outliers of commercial cases.

Third-quarter-Snow patches two to three inches deep.

* This fence is of 18-foot sections of steel mesh 18 feet high, designed to withstand and deflect the blast of jet engines. The sections are bolted sufficiently strongly to fail readily if struck by a landing aircraft. In, from the various directions.

Last quarter—Scattered snow, larger drifts
from 10 to 20 inches deep.

Runway 7R remained open and available for use until closed by the airport management immediately after the accident and by noon that day.

As has been stated, the weather information transmitted by the tower to Flight 93 as it taxied onto runway 7R at about 2007 was precipitation ceiling 300 ft, air obscured, visibility non-quantified, light snow and fog, wind east-northeast 18, gusts to 24, altitude 23.64; runway 9R visual range less than 2,000 ft.

About one month after the accident, the Weather Bureau observed and reported precipitation totaling 100 in. for observed rainfall. One-quarter mile, rain, blowing snow, temperature 20F, dew point 16F, wind east-northeast 18, gusts to 24, direction 206F, memory 48. cloud range less than 2,000 ft.

A few minutes after the accident the pilot of another DC-8, which was preparing to take off after Flight 401, was alerted to taxi up runway TR about 1,700 ft in order to return to his terminal (runway TR was then closed). He reported visibility was approximately 1/2 of a mile and that he observed some patches about one inch deep on runway 4 of the runway. He did not use Flight 401 take off Two tower controllers and some groundmen use Flight 401 during its take-off roll at distances from 3 to 4 of a mile in blinding rain.

The crew of the last flight (like a jolt), taking off from runway 7B before the accident, reported that at the time of their takeoff, 7047, visibility was 1 to 1 1/2 of a mile with ceilings of 300-400 ft., with an improving trend, and that snow was not sticking to their aircraft.

Estimates by Ocean Flight Medical personnel indicate that many depths are necessary for OCS. There is nothing in the record to indicate a depth of more than 50 meters (surface to 50 meters) is sufficient, although it was possible close to that figure at the special end of the career. As LaGuardia Airport, only a few miles east and where neither conditions should not have differed appreciably. The U.S. Weather Bureau examines and reports more conditions. OCS and observations from least one a possible more depth of up to six inches (three to six inches) and possibly at New York International at the end of the record.

Virtually continuous light dry days had fallen and the temperature had remained at about 120° during the second layer the aircraft was parked on the airport between flights.

[illegible]

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³ This fence is of 18-foot sections of steel, each 10 feet high, designed to withstand and deflect the blast of jet engines. The sections are bolted sufficiently frangible to fall readily if struck by a landing aircraft, in, down the escape direction.

¹The whole formulation consisted of gelatin from various sources within 5-7% (total) of animal origin, the same amount of animal origin, the same amount of animal origin, and the same amount of animal origin.



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with a hot pulling just after 11 or 15 sec. of takeoff roll, and eight after rotation and becoming airborne very slowly, the power was established and the aircraft touched down smoothly on all three gears and immediately went into reverse thrust. He would perform landing action from wheel brakes. About this time the aircraft struck some bang, ran off the runway into rough terrain, during which he heard the reading of notes as if a "continuous" series of inquiries by and down and sideways. The aircraft was at rest 12 sec. the last five action.

Most of his passengers thought that the aircraft did leave the ground twice. The captain, based on the apparent falling away of the aircraft, told them that it had. However, several DCS 10 pilots who were riding in passenger seats also saw the aircraft fall away, and they saw one stewardess who was seated at the rear of the cabin. Some passengers on the ground also saw the aircraft fall away. The captain thought the aircraft did leave the runway although it stopped. Two well-qualified ground witnesses saw the aircraft lights leave for a short time, but they did not see the aircraft gain power at the 5,000 to 6,000 ft point on the runway. Others could not see clearly enough, or not at all, so as to see if the aircraft was moving. The aircraft was not seen to leave the runway, and it appeared to have been stuck there in Manning's view.

Aircraft Systems

Investigation of several systems of the aircraft was greatly hampered by covering snow and cold weather. Fire destroyed most of the structure, including a majority of the systems components. An unknown amount of additional damage was caused by the fire-fighting and rescue operations. There was no evidence of fire in one system prior to the accident. No evidence could be found to indicate any system had been malfunctioning.

¹⁰ It has not been determined whether the cabin windows were opened during the time the aircraft was on the ground at New York. The switch controlling the pilot and staff warning outside location was found in the "off" position. There was no evidence of impact to the switch or to the surrounding structure.

The flight recorder had survived the crash and severe ground fire, although a heavy accumulation of mud, limestone, and carbonized residue was found on the exposed portion of the tail which normally would have contained the port engine nacelle. A mixture of hydrocarbon and hydrofluoric acids etched the carbonaceous deposits off the tail but caused some etching of the base.

Examination of the record for a period of at least four days prior to the accident revealed that the recorder had malfunctioned on two occasions. The malfunction resulted in no lateral fuel movement; however, the spillover for the four parameters tested were still strong. Therefore, only a vertical spillover trace was made when the tank failed to advance. The last failure of the recorder occurred prior to the accident of Nov. 79 and the recorder was inoperative.

at the time of the accident. Thus, the fact
 yielded no indication whatever relative to
 the ball's talent.

All these results, however, from rational or turbulent are attributable to loads and disturbances imposed by impact forces. In general, the more blades and more of impact forces, the more the loads and disturbances. In severe rotational damping, CM columns of all impact were normally clean and there were no signs found of subsequent failure zone. All were bearings (not No. 4 or No. 1 engine were imported and found to be of top materials of operational data base). In severe rotational damping, the bearings of the No. 1 engine in the No. 1 bearing zone, and there were no other loads around that would not do the pre-tail condition of this bearing, it was not noticed or reported to anyone at the test. The bearings of all engines would be available for further study.

There were no signs of fuel consumption as any of the five samples taken from the air on each engine and from the tailpipe track. All were below atmospheric levels of 'intake air'. The fuel pumps and fuel controls of engines Nos. 2, 3 and 4 were still operating, those of No. 1 were not and were, therefore, with intake air results. However, there was no reason to suspect any difficulty with the No. 1 fuel pump and fuel control.

In short, the investigations of these four powerplants yielded no indication of any powerplant damage and indicated that they had been producing power as is

The general cluster of wreckage came to rest about 100 ft. beyond Rockway Blvd. in woods, brush, and snow-covered trees on a heading of about 105 deg. mag. and slightly to the right of the established centerline of runway 24.

Five marks of the normal microstratigraphic column were found beginning 7.4 ft down the 10 000-ft survey. They extended 2.23 ft farther down the runway and ended approximately 230 ft from the runway end.

All four engines appeared from the air test. Nos. 1, 3, and 4 came to rest on Rockaway Blvd. close to the main wreckage. The No. 2 engine came to rest on Rockaway Blvd. The left main landing gear also appeared from the aircraft and came to rest on Rockaway Blvd. adjacent to the No. 2 engine. Several other airplane components, parts and many fasteners and wing fragments were dropped over the accident path from the blast zone to the main wreckage site.

Plan Response

Five berles out early during the summer of events after the airplane struck the blast fence. At approximately 150 ft east of this fence and extending about 150 ft is an evenly disturbed ground surface described. A smoothed fragment of the wing leading edge was found approximately 400 ft east of the blast fence. The majority of the destruction of the maps and the findings was the result of the intense and prolonged fire which preceded and followed the explosion.

The bridge was almost completely destroyed by the prolonged fire following the accident. Only portions of the right deck upper structure, the bents and lower

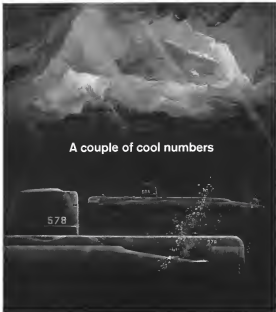
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side panel, and the entrance air area were unaffected. The fuselage had numerous asymmetrically situated, throughout the aircraft sequence except for a partial separation of the right deck section. The first deformation following impact precluded any establishment as to the extent of the damage.

The wing center section and the wings except for these bottom flaps, were automatically consumed by the laser surface test in its original configuration. The left wing from leading edge wing station 733 and rear spar wing station 693 is the top and the right wing from leading edge station 541 and rear spar station 563 is the top view indicated.

The wing flaps were destroyed by fire except for the No. 7 engine exhaust gate, which was torn off. The wing spars, which were extended, were compressed by fire to approximately 10% of their full strength.

The activities from the learned wing legs were in the 11-day takeoff leg position. The remaining right midwing leg did not rise above the remaining right wing quarter talons, was used in the 56-day extended position fix, control gun lock mechanism was in the "off" position and the homestead midline was set 1.21 day month sweep.

The cockpit seats, including the centre console, and control levers, were almost totally consumed by fire. However, the overhead panel, the glass-enclosed fuel tank, and a number of damaged flight instruments were recovered. The pilot lost altitude was listed as 100 ft. "Off" position, both wing leading edge flaps were on, and the main cabin door was on opening, but other flaps were badly inoperative because of the damage. Both engine sections and both KUDs had cracks were in the normal position.

First Heater Condition

The joint heater geometry was traced at the 11 axis positions and discovered it revealed that large expanses of the bearing had moved the hard from zero to that reading. No impact marks were found on the overhead panel downstream of the shroud teeth situated on the trailing edge of overhead and there were no impact marks on the hard rubber joint selector lens.

To estimate growth of the arthropod was failed to locate the correct arthropod prior to the first sample or any part of the arthropod season other than the maximum minimums the new three part and a few short increases of arthropod are shown below.

Only a single part from the air distribution system was found. It was not quite as naked either (as with steel pipes in that part of the tunnel) and no iron formation in the direct aluminum exposed face sections was found.

The suspended indicators were returned with the captain's sword at 80 fathoms (at the ship) and the first officers at 55 fathoms. A knee deposit was found within the captain's instrument, originating from an opening in a bone off line. The Nac 1

*Kailashan Integrated Flight Instrumentation System.

1, 3 and 4 capric propanoic ester units (C18:0) indicated 1.24, 2.19, 2.6 and 2.3, respectively. These values being very close to 2.45, 2.45, 2.5 and 2.2, respectively. The NMR 1, 2, 3 and 4 in hard temperature range indicated 140°C, 160°C, 180°C and 190°C, respectively. The NMR 1, 2, 3 and 4 indicated 1.1 and 1.6, 1.5 and 1.5%, respectively.

The emergency flight control system lowered the leading edge of the last aerial cylinder as designed. The air pressure control system was properly connected and substantially intact. Most of the fuel system, hydraulic system, and electrical system were destroyed.

In summary, there was found no evidence of failure, malfunctioning or fire prior to impact in any of the various parts and components mentioned above.

The parcel was road number 45432 and its total surface area was 129 ha and 34 mm at the time of the accident. Four buses and 19 men were accumulated the day of the accident on the trip from Mexico to New York.

The air unit was delivered to Aeromexico de Mexico at Long Beach, Calif. On Dec. 1, 1980 and flew to the Eastern Air Lines maintenance facility in Miami. The same day, Aeromexico de Mexico and Eastern Air Lines had previously worked out an agreement on the maintenance to be performed on KANX. In contrast to the Eastern Air Lines maintenance procedures and call-draw on the Mexican end of the route, using the same procedures and program as the Federal Aviation Administration approved Eastern Air Lines service, Eastern performed all routine maintenance and always maintained inspectors at the United States and complied with all FAA regulations. Eastern assigned KANX into its own DC-8 maintenance program.

The time since last phage check (No. 2) was 123 hr and 13 min and was completed on Jan. 8, 1960, by Gudrun A. Lewis at Miami, Fla. The time since the last amphiphile check was 12 hr and 14 min and was completed on 1" Feb. at Miami. The last trip check was completed at Midland International Airport, New York, on the day of the accident.

All vehicles on the aircraft except for a lead loading on Nov. 11, 1980 were multimotors of various pieces of equipment as might normally be expected in routine day-to-day operations. The upper parts lead loading operation was completed with no human or laser personnel.

The estimates, however, of the net cost appeared to be robust to any bias which could be significantly related to the accident.

Medical examinations were made on the bodies of the four deceased crew members. There had been no fire, light, heat and no bad food in the lounge immediately aft of the light dock. All four deaths were caused by multiple trauma or gastrointestinal shock and fourth degree burns. Tests for toxicity produced negative results on all four, and there was no significant level of carbon monoxide in any of the four.

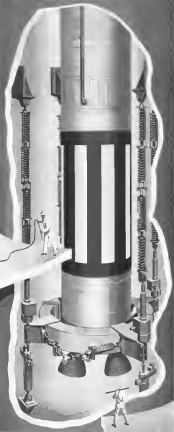
As has been mentioned, F.M. Cape Pond was the only flight deck service. The area

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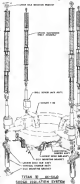
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Runway gradient

Because there are no known data applicable to non-covered runways, the box below is based on a dry, concrete runway.

With respect to the runway lighting, a regulation has dictated that the runway lighting had been changed and that there had been one or more changes in circuit (NOTAMS) on the subject. These changes in lighting were on the last half of the runway. At the time Pac pulled the throttle

the aircraft was still on that portion of the runway which was lighted, it abruptly decelerated and he does not recall any irregularity in lighting on the last end or a failure in illuminating the tailend of the aircraft.

The methods employed for ensuring visibility and some slight fog were such to be deemed. As now provided they are not properly representative of potential runway conditions. The parameters are stated.

Normal Takeoff Profile

Airspeed	Distance	Time	Thrust	Altitude	Altitude
(Knots)	(Feet)	(Secs)	(Lb/ft ²)	(Feet/Min)	(Feet)
100 Kt. Cl.	100.0	30.00	20.0	0.00	—
V _L	120.0	32.70	20.0	3.33	—
V _R	140.0	35.04	30.0	0.00	—
Uplift	124.0	40.00	30.0	0.00	+100 ± 10
V	140.0	50.00	30.0	0.00	+100 ± 10
10 Ft. Alt	140.0	55.00	40.0	0.00	+100 ± 10

(Distances in feet in relation to runway end of runway 740)

Profile for an Abort (Balk) at V_R

100 Kt. Cl.	100.0	30.00	20.0	0.00	—
V _L	120.0	32.70	20.0	0.00	—
Brakes	120.0 ±	37.00	30.0	Forward 10%	—

1. Accelerate Stop Distance (Brakes Only)

9180	Forward 10%	—	0
2. Accelerate Stop Distance (Brakes plus (1) and (2) engine in reverse thrust inhibit power) and (1) and (2) engine in forward 10% thrust)	9180	0.00	—
(1) and (2)	9180	0.00	—

3. Accelerate Stop Distance (Brakes plus all four engines in reverse thrust inhibit power)

3640	0.00	—	0
------	------	---	---

Abort (Balk) at VR (No rotation started)

100 Kt. Cl.	100.0	30.00	20.0	0.00	—
V _L	120.0	32.70	20.0	3.33	—
V _R	140.0	35.04	30.0	0.00	—
Brakes	140.0 ±	—	Forward 10%	—	0

1. Accelerate Stop Distance (Brakes Only)

9180	Forward 10%	—	0
2. Accelerate Stop Distance (Brakes plus (1) and (2) engine in reverse thrust inhibit power) and (1) and (2) engine in forward 10% thrust)	9180	0.00	—
(1) and (2)	9180	0.00	—

3. Accelerate Stop Distance (Brakes plus all four engines in reverse thrust inhibit power)

3640	0.00	—	0
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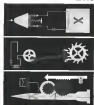
Accelerate to Time of 50 Seconds and 52 Seconds Without Rotation

100 Kt. Cl.	100.0	30.00	20.0	0.00	—
V _L	120.0	32.70	20.0	3.33	—
V _R	140.0	35.04	30.0	0.00	—
10 Sec. Run	300.00	50.00	30.0	0.00	—
52 Sec. Run	300.00	52.00	30.0	0.00	—

Note: Estimated distance in stop aircraft after reaching 300 ft and 520 ft to the runway to 5,000 feet additional of brakes are used and all four engines are in reverse thrust at liftoff power.

Note: Takeoff speed at which aircraft could have left the runway was 130 ft/sec.

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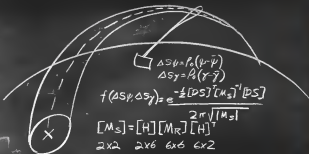
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been appreciably greater than that figure because in descent and minimum velocity, it is apparently did occur at that point as that minimum velocity speed due to the relatively slower descent effect at that speed.

The total three-second average time as speed for Poe to maintain his out fall, stand up, estimate progress, meet the objectives ahead slightly, then close them, when applied to a 2000 ft altitude resulted in a 167 ft/s speed, resulted in a simulated 150 ft/s climb.

This altitude could not have been possible as the aircraft could not have reached down again in a maximum 1,193 ft distance and indicates that the speed at descending velocity must have been considerably less than 167 ft/s.

Thus the altitude speed could not be less than 177.5 ft/s and not at much as 193 ft/s. An average acceleration of 175 ft/s, then a constant speed to the end of the 10-second period, would require 56 sec at 193 ft/s (which no captain is likely to allow). The indicator that acceleration was probably normal to the 100 ft point, but not normal thereafter. The probability exists that after the 100 ft point the speed continued to increase, but more slowly, to the 1534 ft speed at which point then was the accident that the first officer should and probably did not do as V. From this it is clear that when the captain's speed indication was erroneous as Poe was mistaken in thinking that it read 130 ft/s.

Erroneous Reading

On the basis of the following evidence, it is concluded that the captain's speed indicator was giving an erroneous low reading at the time altitude was checked. The first officers observing, as speed indicator, had noted and V. (145 ft/s) immediately thereafter, Capt. Goodrich had pointed to the speed indicator and Capt. Poe in checking the speed on the captain's instrument had read 130 ft/s and advanced, then closed the throttle.

At the time of the accident, the estimated wind velocity was 18 kt with gusts to 24 kt. Such gusts might account for a slight change, but not a 15% increase (138 to 141) to 30% decrease (138 to 116) in the speed indication. It is evident, therefore, that the captain's speed must have been indicating erroneously for some other cause.

The possibility of Glitch entering the speed system through the past heads also are not being ruled out as the accident was explained. Otherwise because both pilot wings were damaged after use of Glitch, the probability of Glitch having affected the speed system appears to be a most unlikely.

It cannot be definitely shown, due to impact and the damage, that an intentional malfunction of the captain's speed system occurred. However, a review of the aircraft's records revealed an unexpected speed system and indicated a satisfactory look level of the speed system for 4-11-64, with no malfunctioning noted thereafter. In addition, the left speed indicator was evidently slow by at least 13 ft/s up to the accident point. This is considerably affecting both systems as extremely unlikely.

As has been stated, it cannot be definitely substantiated that the pilot head indicator



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public, has an important effect on the aircraft's lift-off capability. Therefore, even on the starting run and considered to be a factor in the abnormal landing.

According to Morton Shivers, Eastern's chief pilot and senior instructor, Eastern has changed its cockpit checklist to class rate turning off the pilot seat selector over it is based on pilot to engine start up. At the time of the fatal crash the pilot culture was to turn it off and "go again before takeoff."

DC-8 Capabilities

The DC-8-21 aircraft has the capability of being rotated to its physical limits until the bottom of the winging about 1000 ft. (the runway) and continuing to climb until becoming airborne. Once it becomes airborne, even though rotation has continued to its maximum physical limits, upward movement to increase clearance there are no mechanisms or factors. It is not possible as a DC-8-21 to get on the back end of the power move, i.e., to take the region of operation where the power required is greater than the power available while the aircraft is on the ground. If the angle of attack is not further increased following lift-off, the aircraft would continue to accelerate. Flight tests have proven that maximum rotation at the maximum speed will result in a service rate of climb and the shortest runway distance to lift-off. Once airborne this lift-off performance characteristic will be such that, in a climb, it will be less than the performance of light aircraft V, taking into consideration of engine differences in climb rate, thrust, etc., and speed.

Speed Descent

A speed of descent has been used in the possibility of descending the speed of the aircraft from 110 to 130 ft. per second within the terminal descent or approach area when in the field. To achieve such a descent to ground the descent would have to be 1.44 ft. per second which at the takeoff speed of 270 ft. per second, would require a drop time of 1.94 ft. This descent from the first engine, at between 110 and 130 ft. is approximately 100 ft. Assuming an approach rate of 140 ft. per second it is between 1.44 ft. per second in an additional 110 ft. of drop would be needed upon landing gear to 10 ft. to produce a 0.25 ft. per second. Actually with the descent as with the engine as still producing, since forward thrust is to decrease the effect of the forward drop of the aircraft, the descent of the aircraft, a descent in calculation was made assuming that the aircraft speed was reduced at about 170 ft. per second and this reduced the time to reach the landing to 110 ft.

● 4.5 deg. attitude = 4.5 ft. per second
● 4.5 deg. attitude = 4.5 ft. per second
● 12 deg. attitude = 12 ft. per second
● There have been many too long to be considered in this case. In addition the assumption that the aircraft was held at 170 ft. is false because the engine was apparently operating properly and producing the proper amount of thrust for maximum acceleration. Thus, it can

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in, was that it got into the air and took less than 100 ft to 110 ft in five seconds.

The Board concludes that the accident did become serious. Knowledge of the accident has pointed out that Capt. For was seriously injured if the speed of rotation were appreciably below the estimated 10,000, a longer rollout was would result.

The Board concludes that the rollout was determined as a result of the action of the check pilot, who was not seated in a pilot seat in reaching forward without warning and pulling the throttle back. This action would have been to be determined on all four engines.

Probable Cause

The Board determines that the probable cause of this accident was the unnecessary deceleration of the rollout by the check pilot, who was not in either pilot seat.

The contributing factors in this case were the marginally poor weather, crew on the runway, and the possibility of the pilot brief book not having been on.

By the Civil Aeronautics Board,
Alan K. Reed, Chairman

Robert T. Mearns, Vice Chairman
Clare G. Gandy, Member
G. Joseph Nye, Member
Whitney C. Kilham, Member

The Civil Aeronautics Board was notified of this accident immediately after its occurrence, and an investigation was immediately initiated in accordance with the provisions of Title VII of the Federal Aviation Act of 1958.

Accidents de Mexico reported under United States Civil Aeronautics Board for 1971 are shown in the annual report to the Board, 8-1770, dated Aug. 16, 1971.

A commercial flight in carrier operation, N6 2182, was crashed in the United States Civil Aeronautics Administration, dated Dec. 6, 1971.

Flight Personnel

Capt. Ricardo Gonzalez Delano, age 46, a Mexican National, held a graduate pilot certificate No. 85 (Mexico). He was certified not as a DC-8 captain to the Douglas Aircraft Co. on Nov. 20, 1969, at Miami, Fla. He was rated to the Boeing 747, C-141, DC-8, DC-4, C-119, Brewster and the DC-3. His total pilot time was 15,200 hr, of which 94 hr was as DC-8. He had eight years as DC-8 captain with 95-47 hr, and his total command time in the last three years was 187 hr.

First Officer Antonio Ruiz Bravo, age 32, a Mexican National, held a certificate of license, surface transport certificate No. 99 (Mexico).

Second Officer Norberto Alvarez, age 32, a Mexican National, held a certificate of license, surface transport certificate No. 551 (Mexico).

Capt. William R. For, age 38, a United States National, was a designated Eastern Air Lines DC-8 check pilot, and held a valid surface transport pilot certificate with ratings: A1, A2, A3, Cessation, L-1011, DC-1, DC-4, DC-8, DC-7, and DC-3 as co-pilot. He had a total of 19,400 hr flying time, of which 18,100 was as the DC-8. He had eight years as a DC-8 captain, with a total command time of 1,174 hr.



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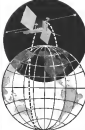
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